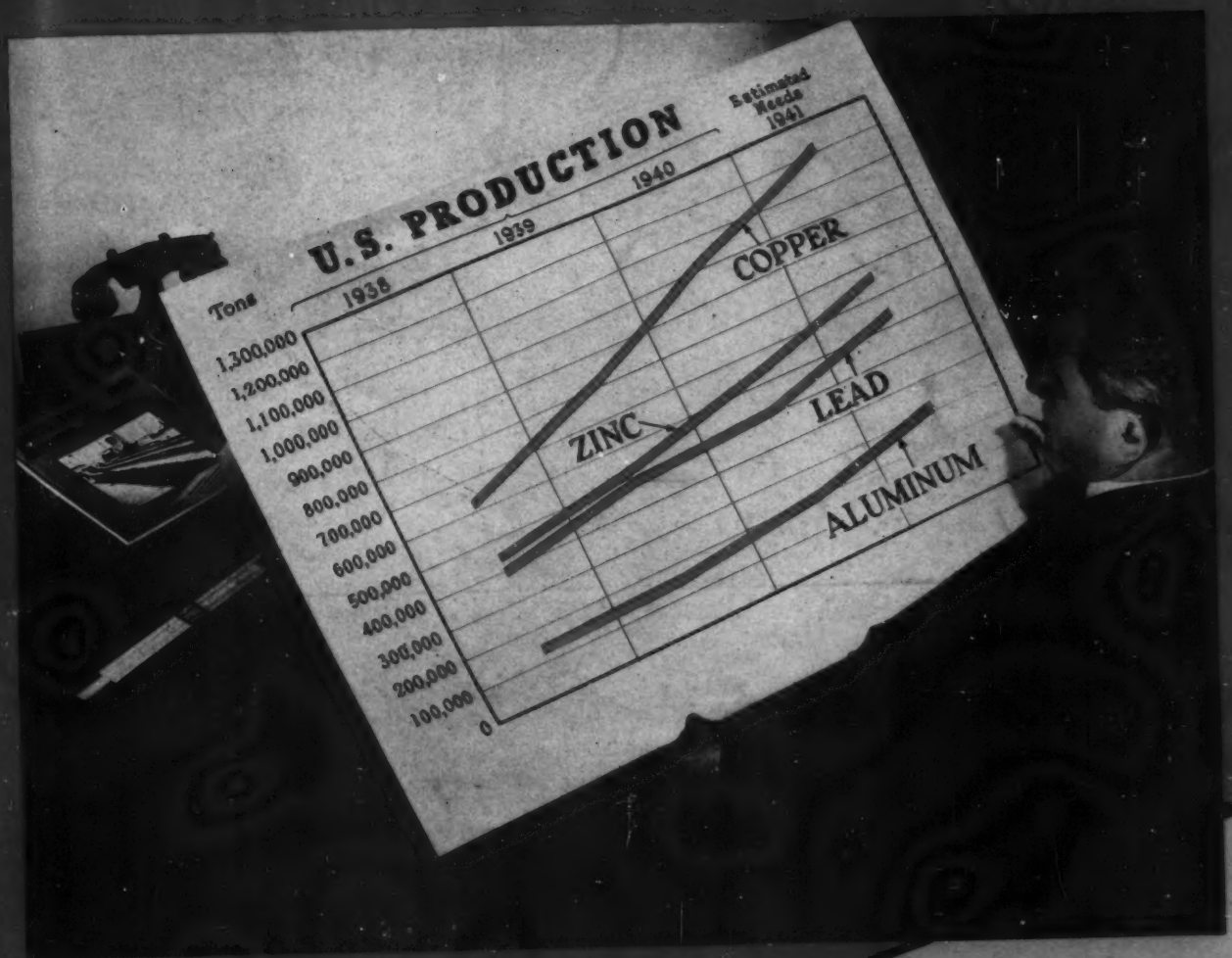
ENGINEERING AND MINING JOURNAL

FEBRUARY, 1941



Graphic evidence of the mining industry's ready response to the call for national defense. Ample supplies of the major nonferrous metals are available for current and future needs

In this issue

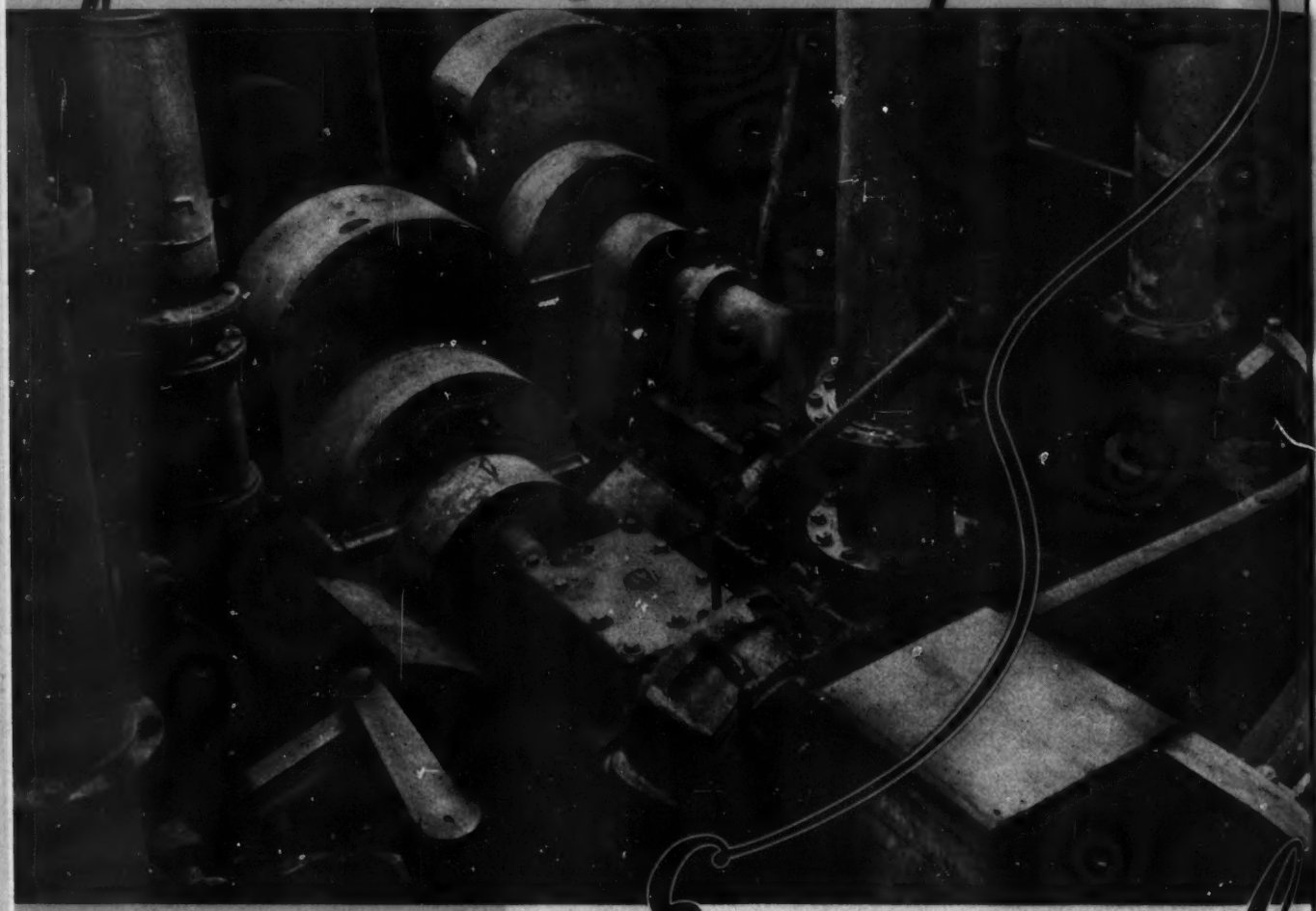
The 72nd Annual Survey and Outlook Number

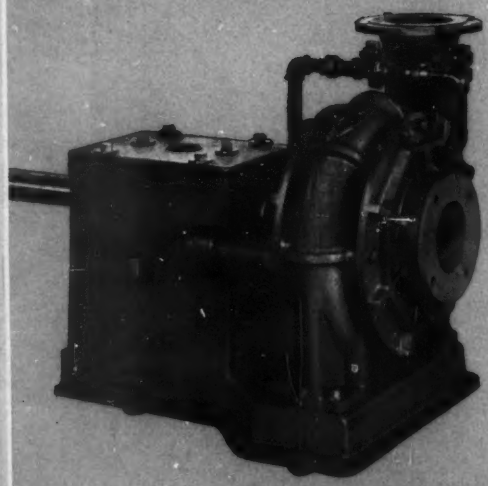
E. & M. J. Metal Prices and Production Statistics

Complete contents on page 37

Price One Dollar

Hydroseal makes Daily Pumping of 22,000 TONS of Solids





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Solids . . . . . 63.7 by weight	Intake pressure . . 0.5 ins. of Hg.
Sp. G. of Solution 1.96	Pump speed . . . . . 435 R.P.M.
Volume . . . . . 3150 U.S. G.P.M.	Power required . . 80.8 H.P.

PUMP EFFICIENCY . . . 61.8%

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This issue not only pegs the past year's progress but also points to many modernizing trends which may develop into the proven practices of tomorrow. This number presents last year's tabulated metal prices for quick reference by months and days, with highlights of depression and boom times also recorded in annual average prices from 1898 through 1940. Regional reviews summarize production and news of 1940 activities in the major fields, while technological improvements in operations and equipment application are outlined for the reader. *E.&M.J.'s* 72d Annual Survey and Outlook Number is invaluable for reference and intensely interesting in its forecast.

▼

"Salting — a pseudo-technical term for the artificial and nefarious enrichment of ore," as T. A. Rickard puts it—forms many a background of truth and fiction in mining annals. Some engineers have had it tried on them, others have never experienced the fraud, but all have heard case histories and stories of the "art" from time immemorial. From old tricks to new, ingenious or crude, the former editor of *E.&M.J.* draws on his wealth of historical background and travel to give the first of a two-chapter story of such businesses in an early issue.

▼

No exact science is geology—and so many eminent geologists are apt to disagree in the detailed interpretation of some specific problem. However, the story is written in the rocks, and, if correctly read, is immensely valuable to the miner. Simply presented, without the use of multi-syllabled terminology in attempted explanation of some complex problem, John Carter Anderson draws a basic pattern for all to read and understand. His Vignettes of Geology will soon be featured in *E.&M.J.*

H. C. PARMELEE
Editor

ENGINEERING AND MINING JOURNAL

H. W. CLARKE
Vice-President

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AMERICAN CYANAMID COMPANY

Review and Outlook

1940 — 1941

ENGINEERING AND MINING JOURNAL

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Volume 142 FEBRUARY, 1941 Number 2

OUTSTANDING in the record for 1940 is the mining industry's magnificent response to the demand for metals and minerals for national defense. When all factors are considered—the apprehension and uncertainty of the first half of the year, the tremendous dislocation of the world's mineral industries by the war in Europe, and the consequent heavy burden thrown on United States producers in the fourth quarter—the record for 1940 is impressive evidence of the nation's mineral resources and the technical skill to exploit them.

WORLD PRODUCTION of precious metals again broke all records. Gold at $35 an ounce took on strategic value as a war metal, particularly in the countries of the British Empire, because it provided ready dollar exchange for purchase of war matériel in the United States. Silver flowed from the mines in larger volume as the production of nonferrous metals increased. But the future of both metals was somewhat clouded with political and economic uncertainty, and we recommend thoughtful reading of our reviews, particularly that of gold, even though some of the opinions there expressed may be unpalatable.

OF THE major nonferrous metals, lead was least affected by the war. Its increased production and consumption may be ascribed principally to greater industrial activity. By contrast, zinc production was violently dislocated, particularly when Germany overran the Low Countries and got control of Belgian smelters. The resulting unprecedented domestic demand put a burden on United States smelters beyond their capacity, and created a temporary shortage of metal that will not be remedied until idle reduction plants can be rehabilitated and new ones built. Domestic copper production at the 12-cent price level practically reached mine capacity in the fourth quarter, and is not likely to exceed greatly the rate then established. Any demand beyond our capacity to produce at this price will probably be met by Government purchases from Latin America.

TIN AND ALUMINUM were in the spotlight in 1940. The Government not only bought large tonnages of tin and concentrates, but stood ready to finance the construction of a tin smelter which private interests were unwilling to undertake. Aluminum featured a tremendous expansion of capacity in an effort to meet the requirements of the airplane construction program. Magnesium shared this prominence with aluminum, but claimed attention in its own right when the Department of Justice instituted criminal anti-trust proceedings against this light-metal industry. To a mere layman it seems inconsistent to harass the industry with a federal suit when other branches of the Government are urging maximum production; but perhaps it's expecting too much for the New Deal to let its right hand know what its left is doing.

WITHOUT GOING INTO DETAIL, it can be said that the procurement of strategic and critical metals and minerals for national defense went forward satisfactorily in 1940. With few exceptions, progress was made in stockpiling these materials. Execution of the complete program was handicapped by shortage of shipping, particularly outside the Western Hemisphere.

THE OUTLOOK for mining in 1941—and after—must be predicated almost wholly on the fortunes of war and the kind of economy that emerges when peace comes. Whether actually at war or not, the United States is operating in a war economy, with all the incidental disturbance of routine business that normally accompanies war. It has been evident for some time that a policy of "business as usual" must be abandoned, and every effort strained for national defense and aid to Britain. So the mining industry can look forward to unusual activity by the Government in (a) price control by moral suasion, "or else"; (b) regulation of metal distribution by priorities; (c) purchase of metals and minerals for current industrial use as well as for stockpiles; (d) loans to friendly nations, to be liquidated sometime by shipments of minerals; (e) economic warfare with totalitarian States, buying metals and minerals more to keep them out of unfriendly hands than because we need or want them; and (f) evolution of a policy for the defense, development, and solidarity of the Western Hemisphere. No one can foresee the resultant of all these forces, but one can forecast a different world—economic, political, and social—and incidentally a bill of staggering proportions.

GOLD

World output shows increase for twelfth successive year. Future obscure.

By a Correspondent

CONTINUATION or acceleration of familiar trends for the most part characterized the year 1940 in the field of gold. Physical production continued the upward course that marked the decade of the 'thirties; the United States was again on the receiving end for huge foreign sales of the metal; and there was no apparent let-up in the spate of literature on gold. The principal element of novelty offered by 1940 stemmed from a remote cause—the military successes of Germany, which aroused considerable interest in the question of the Nazi attitude toward gold and provided a new setting for discussion of the gold problem.

The increase in physical gold output outside Russia appears to have been of the order of 6 percent or about the same as in the immediately preceding year. The figures for the leading producing areas for 1940 and the two previous years are shown in Table I. It is perhaps significant that the rate of increase showed its greatest gain in South Africa, where, in order to prolong the life of the mines, both the Government and the operators had previously held expansion well within possible limits. There thus existed a considerable output potential. Under the stimulus of the higher price established after the outbreak of war, or perhaps as the result of official prodding, South African gold production increased almost twice as much in 1940 as in 1939, adding nearly $50,000,000 to the Empire's internationally spendable resources. Most of the other British producing areas also expanded output to some extent, but except for West Africa, which is still in the developmental stage, the preceding years of rapid growth appear to have brought these fields close to their maximum yields on the basis of present plant capacity; and a period of active warfare is not one in which new investment in gold mining is likely to find favor either with private investors or with the authorities.

Again in 1940 the United States was virtually the only buyer of the world's gold. Its purchases during the year, in fact, reached new heights. At $4,000,000,000, they were equal to the entire gold stock of the United States before revaluation of the dollar in January 1934. The total monetary stock of the United States at the end of the year amounted to approximately $22,000,000,000. Table II compares the increase in United States gold stock since 1933 with that during the preceding twenty years.

The increase in production of gold and in United States holdings has been accompanied by a no less noteworthy increase in the output of literature concerning gold. Only last summer the literary flood had reached such proportions that the research staff of the American Bankers Association found it worth while to issue a digest of the more significant recent writings. The authors and publications cited, covering only those which had appeared in 1939 and the first half of 1940, numbered over sixty.

Unfortunately, many of the proposals for dealing with the gold problem have glaring faults, seldom mentioned by their proponents. Others are completely without merit. In most such cases the error can be traced to the lack of an objective viewpoint concerning gold, to an adherence to old ideas—one may legitimately call them myths—which either were never true in the form in which they became articulated or have ceased to be true in the changed world of today. It is, of course, impossible to review here and discuss the entire recent literature on gold; but it is possible to devote some attention to three mistaken notions which recur persistently in the writings.

One of the most prominent myths is that gold has an "intrinsic" value of a kind enjoyed by no other commodity, and that for this reason it is peculiarly suited to use as money. Sometimes the attempt is made to demonstrate statistically that the cessation of gold purchases by governments would not cause the price to decline, since there would remain a considerable demand for jewelry, filling teeth, hoarding, and other similar purposes. Estimates of the amount of gold used for these purposes, of course, vary, and the figures given in Table II are not to be taken as strictly accurate. Nevertheless, with full allowance for error, these estimates show that the price of gold would fall precipitously if the present volume of output was thrown on a market in which governmental buying was absent.

More often the argument is presented in less concrete terms. It is contended that as long as men want gold, as long as they will make an effort to get it, as long as they will sacrifice to discover and produce it,

Table I—World Gold Production

	In Thousands of Fine Ounces		Percentage Changes From Previous Year		
	1940*p*	1939	1940	1939	1938
Principal gold-producing countries					
North America	11,979	11,628	3.0	8.3	10.2
United States (inc. Philippines)	5,883	5,611	4.8	10.2	5.9
Canada	5,230	5,094	2.7	7.8	15.4
Mexico	866	923	−6.2	.....	9.2
South America	990	895	10.6	9.8	14.0
Colombia	640	570	12.3	9.4	17.9
Chile	350	325	7.7	10.9	7.7
Russia	5,236	5,236	.....	.....	−2.3
Africa	16,426	14,957	9.8	5.6	4.2
South Africa	14,106	12,822	10.0	5.4	3.6
Rhodesia	830	800	3.8	−1.8	0.9
West Africa	965	840	14.9	15.1	17.6
Belgian Congo	525	495	6.1	8.8	5.3
Asia and Oceania	1,936	1,961	−1.3	2.5	11.7
Australia	1,655	1,646	0.5	3.4	15.3
British India	281	315	−10.8	−1.9	−3.3
Total principal countries	36,567	34,677	5.5	5.5	5.6
Other countries	5,369	5,020	7.0	5.9	18.8
World totals	41,936	39,697	5.6	5.6	7.1

p Preliminary

and as long as it is acceptable throughout the world in exchange for commodities, it will have value. These vague contentions beg the basic question. By failing to indicate *how much* gold "men want" or "will make an effort to get," or why it is acceptable in exchange for commodities, the all-important matter of the relationship between demand and supply is evaded. The obvious fact that there will always be a demand for gold and that it will always have some value is not significant. The significant fact is that if gold is demonetized—that is, if governments drop out of the market—its value will decline to a small fraction of what it now is. The value of gold depends upon its continued use as money, not the reverse.

The second of the more prevalent myths is that currency has value only because it can be, or it is believed that some day it will be, redeemed in gold. This idea seems to have originated in the period before governments or government banks issued paper money. In those days paper currency consisted of private bank notes which (as in the case of bank deposits today) depended for their value on the credit of the issuing institution. The final test of the note's value was whether it could be redeemed in legal-tender money issued by the government—that is, in gold (or perhaps silver) coin. The fact that the gold coin was more acceptable than the private bank note only because it had behind it the superior credit standing of the government was obscured by the belief in the "intrinsic" value of gold. Consequently, when governments themselves began issuing paper currency it was thought that the latter, like a private bank note, must be redeemable in gold in order to have value. Actually, both gold and paper are acceptable as money because they carry the government's stamp of approval, and for no other reason. To put it another way, it is its legal tender quality which gives any kind of money its value. The average citizen presumably does not stop to give consideration to the reason why he is willing to accept money readily. But if he should refuse to do so he would soon discover that it is a law of the land that currency may be tendered in satisfaction of any private debt or in payment for local or federal taxes and that he had no practical alternative but to accept money in settlement of any obligation due him; and he would do so with the assurance that his ability to use the money to settle his own obligations was guaranteed by law.

Finally, there is the long-standing belief that gold possesses an inherent ability to regulate the monetary supply. This idea is traceable to the time when knowledge concerning the functions of money was largely limited to the realization that too much money was an evil. Gold was scarce, and by

(*Continued on page* 52)

Table II—Changes in Central Gold Reserves

(In Millions of Dollars)

	December 1933 to December 1940 *a* (at $35.00 an Ounce)	December 1913 to December 1933 (at $20.67 an Ounce)
United States central gold reserves	+15,100	+ 2,800
Other central gold reserves *b*	− 5,600	+ 4,900
Total	+9,500	+ 7,700
Factors of increase	10,375	9,950
Mine output (including Russia)	8,550	8,200
Indian dishoarding	850	.....
Other dishoarding (China, Hongkong, and Egypt)	175	.....
Return from circulation (coin, scrap)	800	1,750
Factors of decrease	875	2,250
Industrial consumption	450	1,350
Indian hoarding	.....	900
European hoarding	425	.....

a Partly preliminary

b Includes estimated change in unreported gold reserves

SILVER

Domestic price fixed by legislation. United States Treasury remains dominant factor.

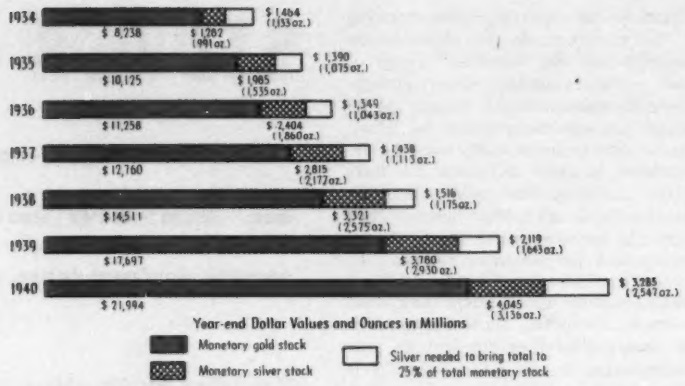
Herbert M. Bratter
Washington, D. C.

THE WORLD SILVER MARKET continued during 1940 to be ruled by U. S. Treasury policy. Excepting for a few days in May and June, the price of silver was almost the sole fixed point in a changing world.[1] The American newly mined metal continued to be taken by the government on the 71c. an ounce basis, under the act of July 6, 1939. Foreign silver, by Treasury policy, continued to be acquired at 35c. an ounce. Acquisitions of foreign silver for the year are estimated at about 145,000,000 oz. and of newly mined domestic silver at about 55,000,000 oz.

In 1940 efforts to secure repeal of the foreign-silver program were renewed and again rebuffed. Chief antagonist was Senator John G. Townsend, Jr., of Delaware, whose bill, S. 785—introduced early in 1939 and later amended so as to apply only to foreign silver—was, over the Administration's objections, finally reported out by the Senate Banking and Currency Committee following new hearings in March and passed by the Senate in May. But the House of Representatives took no action on S. 785, since the bill's friends could not dislodge it from the Ways and Means Committee.

Senator Townsend's efforts to obtain committee action on his bill began early in the year, but made slow progress. The Senate majority leader cited as the reason for the Administration's desire to keep the silver program "foreign policy"—that is, Mexican policy. While Mexico's seizure of American properties had aroused much resentment, others insisted that turbulent world conditions rendered inadvisable any step which might displease Mexico. Therefore, when the Senate subcommittee none the less voted its approval of that measure, Senator Barkley delayed action by the

[1] The exceptions were, May 20-29 when the "official price" rose temporarily as high as 35¾¢, and June 11-14, when it was 35¢.



Silver lost ground in 1940 in attaining the ratio to gold under the Silver Purchase Act, which provides that one-fourth of the total monetary value of gold and silver shall be silver

full committee on the grounds that the President opposed enactment.

On March 19 the Senate Banking and Currency Committee heard the testimony of the Secretary of the Treasury, who urged no change in the program, lest certain "countries with which we have friendly relations" suffer. Next day the full Senate committee voted, 14 to 4, in favor of the Townsend bill.[2] A vote in the Senate could not be procured until May 9, when the Townsend bill passed by 45 to 36.

Although the bill went to the House at once, it met further obstacles interposed by the Administration. The Speaker held it on his desk instead of following the usual course of referring it to a committee. There were reliable reports that the Administration would seek to have the bill returned to the Senate without consideration, as violating the House's constitutional prerogatives respecting revenue bills.

In the absence of House action, Senator Townsend on May 31 again introduced, this time as an amendment to a pending RFC bill (S. 3938), his foreign-silver repealer. The House deadlock continued for two weeks. On June 15 the Finance Committee, by a 14 to 6 vote, tacked on to the pending revenue measure the Townsend amendment to end foreign-silver buying. At the next meeting of the House the Speaker referred S. 785 to the Ways and Means Committee.[3]

The House Ways and Means Committee now had before it two measures seeking an end to foreign-silver purchases. On March 29 Congressman August H. Andresen of Minnesota had introduced a bill (H. R. 9164), identical with the Townsend bill approved by the Senate Banking and Currency Committee nine days earlier. That the bill was referred to the Ways and Means Committee, rather than to the House Banking and Currency Committee, was unofficially attributed to the fact that the Silver Purchase Act contains a tax provision. Actually, considerations of strategy were prominently present.

Since the Ways and Means Committee took no action on silver, the termination of the 76th Congress at the end of 1940 meant that the silver program continued unchanged and any subsequent repeal legislation would have to be introduced afresh in the new Congress.

Among the year's silver bills was one introduced by Senator Sheridan Downey of California (S. 4082), which in part would have authorized the purchase of Mexican silver at the price of American domestic newly mined.

On May 16, eight months after adoption by the Senate of the so-called Wagner resolution (S. Res. 125) for a monetary and banking study by the Senate Banking and Currency Committee, that committee made public a voluminous interrogatory containing more than 2,000 detailed questions. The first section of the questionnaire dealt with silver. That silver was put first in the order of arrangement had more to do with the then current efforts to secure Congressional repeal of the silver program than with the relative importance of the subject as compared with such matters as gold buying, banking policy, etc. At this writing the "Wagner Committee" has not yet commenced public hearings, but it may do so shortly.

Despite the continued acquisition by the Treasury of domestic and foreign silver, due to the much more rapid growth in the country's gold stock by the end of 1940, the statutory goal of the Silver Purchase Act of 1934 was farther away than at the beginning of the year. The desired ratio of silver to total gold and silver set forth in the Silver Purchase Act of 1934 is 25 percent. In December 1939, also a year of large gold imports, the actual ratio averaged only 17.7 percent, as compared with 19.1 percent in 1938. By October 1940 the average ratio had further declined to 15.7 percent.

The Federal Advisory Council of the Federal Reserve System on Feb. 20 urged immediate cessation of the buying of foreign silver. In November Chairman Eccles of the Board of Governors of the Federal Reserve System made a significant speech on central-banking policy in which he pointed out the direct relationship between gold and silver buying and the excess reserve situation and advocated drastic amendment of the gold and silver policies to keep the metal inflow from further swelling reserves and deposits.

Silver was hardly heard of as a national issue in the 1940 campaign, even though the Republican "textbooks" devoted attention to it. The Republican platform of 1940 took a stand opposing "the President's arbitrary authority to manipulate the cur-

(*Continued on page* 55)

[2] The committee's report (Senate Report No. 1332) set forth the main reasons for its action.

[3] The amendment was then struck from the tax bill when it came before the Senate of June 18.

WORLD'S SILVER PRODUCTION — In Fine Ounces

Country	1937	1938	1939	1940
United States	69,315,000	58,736,000	57,808,000	66,500,000
Canada	22,977,751	22,219,195	23,116,861	24,500,000
Mexico	84,678,921	81,016,939	75,869,000	84,000,000
Peru	17,453,331	20,552,177	18,200,000	18,800,000
Other America	20,684,739	17,784,234	18,638,865	18,500,000
Europe	19,687,849	22,240,840	22,127,714	22,100,000
Australia	14,835,821	15,064,645	15,449,079	15,500,000
Japan	10,000,000	10,000,000	11,000,000	11,000,000
India	6,880,000	6,450,000	6,830,000	6,800,000
Other Asia	3,853,530	4,325,653	4,513,970	4,400,000
Africa	5,278,103	5,689,788	5,364,255	5,400,000
Totals	275,645,045	264,079,471	258,917,744	277,500,000

Refinery output. Figures for 1937, 1938, and 1939 by American Bureau of Metal Statistics; 1940 *E. & M. J.* estimate.

COPPER

War demand resulted in all-time high in world production. Price remained steady.

H. H. Wanders
Market Editor
Engineering and Mining Journal

WHEN COMPLETE RETURNS for 1940 become available, they will probably show that world production of new copper established an all-time high of about 2,650,000 tons. The previous high was slightly under 2,500,000 tons, in 1937. Increased production in the British Empire and the United States contributed in no small measure to the gain in output.

Uncertainty and indecision marked the first half of the year, all because of the military collapse of Norway, the Low Countries, and France. Great Britain's decision to carry on, and the "all-out" action here on national defense, completely altered the complexion of the domestic market for copper in the second half of 1940. Production was sold up and the supply situation here became frozen.

Despite the exciting last six months of the year, the average price of domestic copper was not much higher than in the year previous. The *E.&M.J.* average for 1940 was 11.296c., f.o.b. refinery, against 10.965c. in 1939. Foreign copper averaged 10.770c., refinery, in 1940, against 10.727c. in 1939.

Indirect price control in domestic copper by the authorities in Washington kept the price situation from getting out of hand. The month of September set a new monthly high in sales to domestic consumers, when 254,277 tons were disposed of in a rising market, the price advancing 1c. The buying continued active throughout the last quarter of 1940 and sales for the entire year totaled 1,109,000 tons, which contrasts with 807,000 tons in the prior year. To control the market in the active October-December period, large mine operators had to resort to allocation of business, which proved effective.

Toward the end of the year, prompt copper of domestic origin was almost unobtainable. Fabricators who booked additional business in various copper products that called for early delivery paid a premium. The sale of so-called premium metal was confined to custom-smelter copper and some moderate tonnages released by small producers.

In boom periods of the past, it was taken for granted that the price of copper would rise to bring in marginal production as needed. Both producers and consumers subscribed to this view until it was explained by economists in Washington that the cost of producing 5 or 10 per cent of high-cost copper should not establish the price of the major proportion of the country's output. Consequently, arguments presented by groups of high-cost producers for an upward revision of the 12c. basis failed to produce visible results.

That the National Defense Advisory Commission strongly opposed rising prices in essential war materials was made clear to all industry. Late in

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WORLD'S COPPER PRODUCTION — In Short Tons

Country	1937	1938	1939	1940
United States	834,835	556,673	734,990	907,000
Canada	262,432	290,200	310,257	375,000
Mexico	51,538	45,662	53,790	40,000
Chile	455,562	387,409	373,870	390,000
Peru	39,351	41,368	39,021	40,000
Germany	32,518	33,069	33,000	35,000
Russia	101,963	108,000	118,000	120,000
Spain and Portugal	34,546	37,964	28,439	38,000
Japan	83,665	84,900	84,900	80,000
Africa	416,328	395,337	392,175	410,000
Elsewhere	185,955	206,455	214,199	215,000
Totals	2,498,693	2,187,037	2,382,641	2,650,000

Statistics based on blister copper, so far as possible, and referred to countries wherein ore originated. Does not include secondary copper. Figures for 1937, 1938, and 1939 by American Bureau of Metal Statistics; 1940 *E. & M. J.* estimate.

LEAD

Imports supplement supply in meeting large demand, but also act to depress price.

F. E. Wormser
Secretary
Lead Industries Association

TO AN EXTRAORDINARY EXTENT the war has focused the attention of foreign lead producers on the United States as an outlet for their lead supplies. As the normal European market for the lead production of Mexico, Canada, Australia, South America and other countries has been cut off by the war, the last remaining important market for foreign lead producers is the United States. It has been, therefore, a logical economic development for unusualy large shipments of lead in the form of ore and concentrates, base bullion, or, more important still, refined pig lead, to be drawn to the United States looking for domestic purchasers.

For the first eleven months of 1940 lead concentrate and matte imports were about 98,000 tons compared with 26,000 for the corresponding period in 1939 and, in the case of pig lead, the corresponding ratio was 141,000 tons compared with 3,400 tons, respectively. Mexico, by reason of its proximity and resources, was by far the most important shipper of lead into the United States and its imports were principally in finished pig lead form. Only a part of the Mexican imports have been sold domestically, the balance remaining in bond to await disposition either in the local market, reshipment abroad as a raw material, or conversion into finished lead manufactures for export under benefit of drawback under our customs regulations.

Lead concentrates have been shipped to the United States mainly from Newfoundland, Australia, and South America, about 2,000 tons a month (lead content) coming from Newfoundland, on the average, and 1,600 tons a month from Australia. Argentina and Peru shipped an average of 1,300 and 1,400 tons per month respectively in 1940. On the other hand, Mexican pig lead imports have

averaged about 12,000 tons a month. Without the tariff protection now enjoyed by the lead industry the situation would be serious indeed, as the constant pouring of large tonnages of lead into the United States could not be done without driving the market to such disastrously low levels that domestic mines would have to shut down. Owing to the extraordinarily large and growing domestic demand for lead, it was fortunate, in a way, that supplies of lead were available from foreign countries to supplement the domestic supply.

Pressure of the unusually large supplies of foreign metal has had a depressing effect upon the domestic market, so that the lead price dipped during the summer, to recover some strength in November, and declined again in December. At the beginning and close of 1940 lead was 5.50c. per pound New York. The high was 5.80c.; low, 4.75c.; and the average, 5.179c.

Average Yearly Price of Lead

Cents per Pound New York

1922	5.734	1931	4.243
1923	7.267	1932	3.180
1924	8.097	1933	3.869
1925	9.020	1934	3.860
1926	8.417	1935	4.085
1927	6.755	1936	4.710
1928	6.305	1937	6.009
1929	6.833	1938	4.739
1930	5.517	1939	5.053

Although the domestic position of lead is strong as shown by (1) the excess of shipments over production and (2) a decline in domestic pig lead stocks almost to the vanishing point, the domestic picture is likely to be misleading without consideration of the foreign lead situation. For example, there are upward of 100,000 tons of Mexican lead in the United States in bond that are naturally not included in the domestic statistics. The table in column two gives the changes in the domestic picture.

Lead Imports from Countries Shown

In Short Tons

Lead concentrates (lead content)	1938	1939	1940 (11 mos.)
Newfoundland	....	....	23,227
Mexico	24,023	3,847	1,580
Argentina	4	3,362	16,469
Peru	9,313	7,176	13,965
Australia	6,444	7,613	16,581
Canada	3,161	5,624	8,009
South Africa	....	....	6,080
Base Bullion			
Mexico	14,444	47,914	17,258
Pigs and Bars			
Peru	1,736	3,304	14,472
Australia	225	1,118	2,800
Mexico	....	....	123,648

Change in the Domestic Production, Shipments, and Stock Position of Lead (a)

In Short Tons

	1939	1940(b)
Mine production	462,200	475,000
Secondary and foreign production	35,800	100,000
Domestic shipments	555,100	605,000
Refined pig lead stocks (Dec. 31)	58,800	30,000
Total stocks all forms (Dec. 31)	148,100	140,000

(a) Based upon A. B. M. S. statistics.
(b) Estimated.

Receipts of old lead battery plates and parts were even less in 1940 than in 1939 and the production from the scrap lead industry as a whole is believed to be little different from what it was in the previous year.

It is well known that the amount of lead available from domestic mines depends largely on the price—the higher the price the more metal produced by miners in the Rocky Mountain area, and vice versa. Statistics indicate that there hasn't been much increase in domestic lead mine production—only 2 percent—partly because the domestic lead price has not been attractive enough, and partly because of the restrictions imposed by the 40-hour work week.

The lead industry will stand to benefit in the long run if the comparatively low price of lead continues. During the last war lead rose to unusual heights and substitutes were developed to displace uses of lead that have never been recovered. Lead is competitive in many fields with practically all other non-ferrous and ferrous metals, and, so long as the price of lead relative to other metals is low, its uses should not be disturbed greatly but should even increase.

In tracing the use to which the larger domestic lead shipments have been put, it is noteworthy that the cable industry has increased its requirements about 50 percent over 1939, or close to 100,000 tons. An even larger demand is anticipated in 1941 for lead from the telephone and power companies for defense purposes. Likewise, the ammunition industry has increased its lead consumption from about 25,000 tons in 1939 to 35,000 in 1940.

For the first time in many years the storage-battery industry will probably not have first place as the principal consumer of new lead, yielding that distinction to the cable industry. The demand for lead pigments has not shown much variation except that white lead in paint form, the most important pigment, registered a decline in 1940, largely because of the unsatisfactory paint situation during the spring painting season. Large orders for paint in connection with the War Department's painting requirements at the year-end indicate that the demand for this standard pigment will be greater next year. Increased business for lead products, particularly chemical sheet lead and lead plumbing goods, have been noticed.

Regardless of what the future may have in store for additional lead requirements, particularly if the war continues, one thing is clear: there is no shortage of lead supplies in sight.

WORLD'S LEAD PRODUCTION — In Short Tons

Country	1937	1938	1939	1940
United States	469,892	379,636	420,427	460,000
Canada	205,479	204,646	196,059	205,000
Mexico	254,810	267,530	237,742	220,000
Germany	179,014	189,265	200,000	210,000
Belgium	97,002	99,758	105,821	.....
Italy	43,520	47,741	42,000	42,000
Spain	33,069	39,683	29,800	35,000
Russia	60,627	76,059	82,700	85,000
Australia	258,415	259,771	278,200	280,000
Burma	87,024	89,712	86,666	84,000
Elsewhere	206,639	224,728	219,553	.....
Totals	1,895,491	1,878,529	1,898,968	.....

In terms of base bullion, allocated so far as possible according to country of origin of ore. Figures for 1937, 1938, and 1939 by American Bureau of Metal Statistics; 1940 *E. & M. J.* estimate.

ZINC

Plant expansion necessary to meet war demand. Production and consumption balance

Marshall L. Havey

Vice President
The New Jersey Zinc Co.

IN REVIEWING the zinc situation in 1940, the outstanding influence of the European war is plainly evident. In the early months of the year, when the war was not prosecuted to the full, the zinc situation was also quiet. Prime Western zinc did not go above 6c. or below 5½c. between the end of 1939 and June of 1940. Production and shipments were approximately in balance, with about six weeks' supply in the hands of producers. Requirements of the warring countries in excess of their own and their territorial production were being purchased from neutral European countries because of proximity and to improve trade relations.

Then came May and the German subjugation of Norway and Belgium, both of which were prominent zinc producers. In that month it was reported that England had purchased several thousand tons of slab zinc in America, and this demand, added to a strengthening United States position due to our own increased industrial activity, definitely changed the complexion of the market.

As the months passed, the demands for zinc increased, not only because of increased requirements of the zinc-consuming industries, due to domestic and foreign business, especially for British defense, but also because these industries were anticipating a tight situation in the zinc market and were covering ahead.

The American zinc industry was thus placed in a difficult position. For a period prior to the present war, American producers of zinc were contending rather unsuccessfully with imports of foreign zinc at prices against which the tariff in effect before the reciprocal trade treaty with Canada would have been inadequate, and the lower tariff provided in the Canadian treaty was of even less protection. Thus the zinc producers, with a total mining and smelting capacity more than sufficient to care for very substantial domestic industrial demands, plus the requirements of a United States defense program, had been faced with shutdows, some of which actually took place, and with the problem of keeping up needed repairs in the face of such low prices.

In the fall of 1940, therefore, there was this domestic demand for immediate and future requirements; a demand from Great Britain for zinc in slab form and as a component of brass or as galvanizing; and an increasing demand for the defense program of the United States. While some of the British requirements for slab zinc were covered by imports of ore provided by Great Britain, this did not lessen the demand on the zinc smelters. Steps were promptly taken to rehabilitate existing smelting capacity, and increases in capacity are being rushed, but, as with all activities necessary to our defense program, time

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WORLD'S ZINC PRODUCTION — In Short Tons

Country	1937	1938	1939	1940
United States	589,619	456,990	538,198	643,386
Canada	158,643	171,656	178,301	187,000
Mexico	40,364	41,338	50,989	38,000
Belgium	248,656	231,924	204,697	.....
France	66,611	68,532	66,427	.....
Germany	180,006	212,173	234,000	.....
Great Britain	69,597	61,938	55,600	.....
Poland	120,512	122,119	130,000	.....
Australia	78,120	78,198	78,000	79,000
Russia	77,161	88,184	99,200	105,000
Elsewhere	209,198	219,278	214,300	.....
Totals	1,838,487	1,752,330	1,849,712	.....

Production by primary metallurgical works. Figures for 1937, 1938, and 1939 by American Bureau of Metal Statistics; 1940 *E. & M. J.* estimate.

TIN

Buying of metal and concentrates by U. S., and plans for smelter, set pace for industry

H. H. Wanders

Market Editor
Engineering and Mining Journal

STIMULATED by the obvious need of accumulating a large reserve of tin against all contingencies, measures were adopted in the United States during 1940 that set the pace for the world's tin industry. The metal was purchased on an unprecedented scale, contracts were signed to acquire Bolivian concentrate, and plans were discussed for the construction of a tin smelter in this country.

To meet the heavy demands for tin, world production was increased appreciably under the direction of the International Tin Committee. Output for 1940, measured in terms of ore production, was 233,100 long tons, a new all-time high. Production during 1939 amounted to 183,900 tons. The previous high was 209,100 tons (1937).

On July 1, Federal Loan Administrator Jesse H. Jones announced that the Metals Reserve Company had been formed to purchase about 75,000 tons of tin as metal over the period of one year. The large deal, to acquire the metal on the basis of 50c. a pound, c.i.f. United States ports, was concluded within the framework of the international tin accord. Provision was made for the orderly marketing of the emergency stockpile at the expiration of the emergency so that the price structure would not be upset.

Immediately after the authorities in Washington announced the stockpile deal, the International Tin Committee acted on the supply situation and raised permissible tin exports of countries in the control plan to the record rate of 130 percent of standard tonnages, effective for one year beginning with July 1, 1940.

Though detailed production statistics are not available, it is known that Malaya alone produced more than 85,000 tons of tin during 1940, the largest single year's tonnage produced in that area. The Netherlands East Indies produced approximately 44,000 tons, also a new high.

Export quotas, usually referred to as production quotas, established by the control group over a period of the last three years were as follows:

	Percent of Standard		
	1938	1939	1940
First quarter	70	35	120
Second quarter	55	40	80
Third quarter	35	120	(a)130
Fourth quarter	35	100	130

(a) Originally established at 100 percent in May; revised in July.

Actual consumption of primary tin in the United States during 1940 was estimated at 74,000 tons, or several thousand tons above the average of what may be accepted as a normal year. Total supply available was well in excess of the amount consumed, indicating that private industry and the Government stocked tin. Deliveries of primary tin during 1940 totaled 115,497 tons. Figures on use of tin and deliveries are not comparable, owing to a lag of a month or more in the two positions.

Consumers of tin in the United States were confident as 1940 ended that sufficient metal was on hand and on order to provide for a full year's needs, estimating consumption for 1941 as between 75,000 and 80,000 tons. Trade authorities believe that the Government alone holds title to 40,000 tons of tin as metal. Consumers financially able to store tin in volume added to their inventories.

The Government's entry into the tin market around mid-year naturally colored all opinion about the probable course of prices. Excepting a sudden disruption in supply lines, the trade leaned strongly to the view that the price named by the Metals Reserve Company would, in effect, establish a minimum quotation for tin. This interpretation of the price outlook proved to be correct. Whenever private industry entered the market for substantial tonnages, the price firmed up, but as soon as this demand ceased, the quotation dropped back to the equivalent of 50c. a pound for Straits and the Government came in as a buyer.

In the light of the world-shaking events of 1940, the spread in prices for the twelve-months' period was not great. The high for the year was 58c. in June, the low 44.75c. in April, and the average for all of 1940 was 49.827c., which compares with 50.323c. for 1939.

Another measure proposed during 1940 to assure an adequate supply of tin, come what may, was the decision taken in Washington to back construction of a tin smelter to treat Bolivian concentrate. Hemisphere defense undoubtedly had a bearing on the move to build a smelter. Early in October it was revealed that eight proposals for the construction of a smelter had been submitted to a technical committee appointed by the Government for proper evaluation. Quick action was promised, but up to the end of 1940 the project was still under advisement. The smelter was to have a capacity to produce 18,000 tons of tin a year.

Two companies had pilot plants in operation during 1940—Phelps Dodge Refining Corp., and the American Metal Co. However, the extent of this country's entry into the smelting of tin during the last year may be gaged by the importation of only 2,781 tons of tin contained in ore or concentrate in the first eleven months of 1940. Out of the total quantity imported, 2,088 tons originated in Bolivia; 288 tons in Argentina; 291 tons in Mexico; 29 tons in Portugal; and 85 tons elsewhere.

Profiting by the experience gained in smelting tin in the United States in the first World War period, private interests moved slowly in the matter of launching a new enterprise. Without sufficient protection, it was generally recognized that tin smelting here would have a difficult time surviving economically in a really competitive market.

Contracts were signed by the Metals Reserve Company and representatives of the middle-size and small tin mines in Bolivia on Nov. 4 for ore or concentrate to be supplied at the rate of 18,000 tons (tin content) a year over a five-year period. Patiño, the largest Bolivian producer, being obligated to supply concentrate to British smelters, did not participate in the final transactions with Metals Reserve. As in the acquisition of the tin as metal, the ore and concentrate contracts were closed to fit into the international control agreement. For the first 18,000 tons of tin in ore, if made available before July 1, 1941, the buyer agreed to settle on the basis of 48½c. a pound of tin contained, f.o.b. United States ports, less treatment charges and penalties for impurities. Thereafter, the market price is to be used as a basis for settlement.

The shipping situation looms as the number one problem for the tin industry in 1941. Control of the price paid for tin in this country appears to rest with the authorities in Washington. Owing to what many in the industry regard as unnecessary delay, tin smelting on a large scale may not get under way here until the first quarter of 1942. Shipping complications, should the war spread, may bring some enforced curtailment in the use of tin in this country during the coming year.

WORLD'S TIN PRODUCTION — In Long Tons

Country	1937	1938	1939	1940
Boliva	25,024	25,371	27,215	37,100
Great Britain	1,987	1,999	1,800	1,800
China	10,500	11,000	11,000	11,000
Burma	4,636	4,950	5,400	5,200
Malaya	77,542	43,247	55,950	85,000
Thailand (Siam)	16,494	13,520	16,991	17,000
Netherland E. I.	39,825	21,024	31,281	44,200
Nigeria	10,468	7,305	10,855	10,200
Belgian Congo	9,024	7,318	9,663	8,600
Australia	3,253	3,329	3,500	3,500
Elsewhere	9,524	9,582	9,986	9,500
Totals	208,277	148,645	183,641	233,100

Production of tin on ore basis. Figures for 1937, 1938, and 1939 by American Bureau of Metal Statistics; 1940 *E. & M. J.* estimate.

COPPER

(*Continued from page* 45)

September, as the price structure in copper strengthened, the copper industry was warned that direct Government control of prices was imminent if the price pressure continued. At the same time, the authorities in Washington emphasized that voluntary price control was the true aim of the Government.

As a control measure, effort was directed toward determining the future needs of copper consumers. Production of domestic copper for 1941 was placed at about 90,000 tons a month, or 1,080,000 tons for the entire year. Estimated use of copper in the United States for 1941 was placed at 1,200,000 tons, of which total defense needs alone would account for 300,000 tons. Any deficiency between domestic production and consumption could be wiped out by bringing in foreign copper.

The suggestion to stockpile foreign copper had substance to it, for on Dec. 19 Federal Loan Administrator Jesse H. Jones announced that the

Metals Reserve Company, organized earlier in the year to acquire strategic minerals and metals, had contracted to purchase 100,000 tons of Latin American copper for delivery in 1941 as follows: From Anaconda, 57,000 tons; Kennecott, 28,000 tons; American Metal (sales agents for Cerro), 10,000 tons; and Phelps-Dodge, 5,000 tons. The metal was purchased on the basis of 10c. a pound, f.a.s. United States ports. The deal to purchase foreign copper calmed buyers.

Details of the foreign position of copper at the end of the year were not available. During 1940, however, the principal Empire producers of copper renewed their contracts with the British Ministry of Supply on virtually unchanged terms. The British war materials program probably prevented the substitution of copper from Empire sources for use in the United States to aid on British orders for fabricated materials. South American production, because of the shipping situation and the dislocation of regular markets, cleared most of its copper through United States ports. Japan, Great Britain, and Russia were the chief customers. Exports of purely domestic copper from the United States, excluding copper in fabricated form, fell from 134,152 tons in 1939 to 45,537 tons in 1940.

The extent of the influence of export business in copper products on our market was pronounced toward the end of the year. In the steel industry it was generally admitted that fully 25 percent of the domestic production was export business. Apparent consumption of copper in the United States during the fourth quarter averaged a little above 100,000 tons a month. To say that 15 per cent of this large tonnage went for export is probably conservative.

The supply situation in copper for 1941 should present no great problem. The United States can produce 1,000,000 tons of copper a year. Latin America could contribute as much as 500,000 tons a year, if necessary. The British Empire may be in a position to furnish copper against fabrications here for its own account. The real difficulty in the domestic market as 1940 ended was not an insufficient supply of copper, but more likely uneven distribution.

Price uncertainty for 1941 appears to have been largely removed. Exports have been placed under control. The expanding war economy will call for large tonnages for a long time to come. Hemisphere defense may divert larger tonnages of Latin American copper to these shores. Yet the future of copper remains tied to the war. Actual consumption or use of copper in this country at the rate of 100,000 tons a month for an entire year is a large order and claims as to probable needs should be weighed with care.

MINOR METALS

Unusual significance attached to these metals and minerals in 1940 on account of their importance in national defense and difficulty in procurement from abroad

Metals Economics Division

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THE MINOR METALS assumed unusual significance in 1940. Five of the thirteen commodities discussed under this heading are classed as strategic by the Army and Navy Munitions Board, and two are designated as critical.

The catastrophic collapse of the Allied armies in western Europe in the spring of 1940 emphasized the necessity for the United States to rearm swiftly. The Government stockpiling program, inaugurated in 1939 by the Procurement Division of the Treasury Department under the Strategic Materials Act (Public 117), was augmented by the creation of the Metals Reserve Co., a subsidiary of the Reconstruction Finance Corporation.

Metals Reserve has concentrated chiefly on manganese, tin, tungsten, and chromium, and the Procurement Division has bought other commodities. At the close of the year large quantities of foreign and domestic products had been contracted, but deliveries were small owing to shortage of ships for transporting foreign ores and to delays incident to bringing new domestic operations into production. As a further precaution, the Government imposed license control on exports of the strategic and critical minor metals in late August.

Statistically, the minor metal industries in 1940 recorded substantial increases in consumption and in some instances domestic production. Despite difficult shipping conditions, imports were at exceptionally high levels.

ANTIMONY—New York quotations of antimony remained unchanged during 1940 at 14.0c. a pound for domestic and 16.5c., duty paid, for Chinese metal. Supplies of the latter continued meager. Imports for eleven months included 203 short tons of regulus, 13,851 tons of antimony ore (antimony content), and 113 tons of needle or liquated antimony, compared with 1,034, 8,286, and 212 tons, respectively, in 1939.

Detailed field work in Valley County, Idaho, by the Bureau of Mines revealed substantial bodies of antimony ore, and shipments from new operations were made during the fall. Domestic smelters were active throughout the year at increased rates of production. The new plant at the Bunker Hill smelter, Kellogg, Idaho, was placed in operation during 1940, recovering antimony from local tetrahedrite concentrates.

The Government is stockpiling antimony. Several thousand tons of Chinese metal have been contracted for by the Metals Reserve Co., and substantial deliveries already have been made. These shipments are not included in official import statistics.

ARSENIC—Increased smelter activities in 1940 probably resulted in a record domestic production of white arsenic. Imports, however, declined from 14,674 short tons in 1939 to 9,520 tons in eleven months of 1940, owing chiefly to curtailment of receipts from Europe. Domestic consumption in insecticides was below normal because cotton boll-weevil and grasshopper infestations were mild. Quotations for white arsenic advanced from 3 to 3¼c. per pound in July and to 3½c. in November.

BISMUTH—World production of bismuth in 1940 continued at the high level established in 1939. While metallurgical uses increased, pharmaceutical uses probably declined. The war has restricted international trade and encouraged the use of substitutes.

CADMIUM—The average price for commercial sticks in 1940 was 79.92c. per pound, compared with 59.18c. in

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1939. The premium for special anode shapes was unchanged at 5c. a pound. Imports of metallic cadmium for eleven months totaled 27,491 lb., compared with 309,874 lb. in all of 1939 and 22,582 lb. in 1938. Domestic production is estimated at about 6,800,000 lb., compared with 5,090,000 lb. in 1939, including cadmium recovered from Mexican flue dusts, imports of which during the first eleven months of 1940 were 874 tons, compared with 816 during the like period of 1939.

CHROMITE—Increased demand for chromite and an increasingly difficult shipping situation, with accompanying heavy freight rates, caused much higher prices in 1940. Quotations were nominal, and at the end of the year all ore offered was being moved as rapidly as ships could be made available. Despite these conditions, domestic consumers improved their large stock position during the year, and purchases and deliveries to Government agencies continued.

Imports totaled 582,399 long tons for the first eleven months of 1940, compared with 273,483 tons for the same period of 1939. Supplies from Turkey, Greece, and Yugoslavia during the latter half of the year moved slowly owing to conditions in the Mediterranean.

Domestic purchases of chromite for stockpile purposes by the Procurement Division of the Treasury Department continued through 1940, but activities were hampered by shortage of ships, high prices, and high ocean freight rates. Because of limited funds available, purchases under this act were limited to metallurgical grades only. Purchases of refractory and chemical grades of chromite were inaugurated late in the year by the Metals Reserve Co. upon recommendation of the Advisory Commission to the Council of National Defense. Significant tonnages have been purchased, but movement to this country has been delayed by shortage of bottoms.

Exploratory work by the Bureau of Mines and Geological Survey continued. Deposits in Montana, Oregon, Washington, and Alaska were mapped, test-pitted, or drilled. The largest reserve indicated to date is in Sweet Grass and Stillwater Counties, Mont., but the ore is off-grade. Tests by the Bureau of Mines indicate that the ore can be concentrated to a product at least suitable for the chemical industry.

Domestic production of chromite was less than 3,000 tons, chiefly from the Pilliken mine, in El Dorado County, Calif. Higher prices and the Government purchasing program may result in a substantial increase in 1941.

COBALT—Cobalt-bearing residues from Belgian Congo, formerly shipped to Belgium, are now being shipped to the United States for conversion into metal, oxide, and salts. Imports from Finland ceased, but shipments of ore from Canada reached an all-time high. Receipts during the first eleven months of 1940 included 2,175,689 lb. of ore and 30,000 lb. of metal from Canada, 4,893,565 lb. of cobalt-bearing residues from Belgian Congo, and 100,321 lb. of metal from Belgium. Imports of unrefined cobalt in 1940 were more than ample to take care of domestic requirements. Exports of cobalt metal and oxide are now subject to license control.

MAGNESIUM—Domestic production of magnesium metal is estimated at 12,500,000 lb. in 1940, and double this quantity is expected in 1941 as a result of the completion in December 1940 of a new plant to recover the metal from seawater at Freeport, Tex. Apparent consumption in 1940 increased 50 percent over the previous peak in 1939 because of the accelerated aircraft program and the greater use of magnesium per plane. Of the magnesium consumed, probably 65 percent was used in fabricated products, 30 percent in aluminum, zinc, and other alloys, and 5 percent as a deoxidizer and in pyrotechnics, chemicals, etc. Late in 1940 fabricators of magnesium products began to expand plant facilities and to operate on a three-shift-a-day basis. Price of the metal remained constant at 27c. per pound throughout the year. No metal was imported but a substantial quantity was exported, chiefly to the United Kingdom.

In December 1940 the Federal Bureau of Mines began pilot-plant tests at Pullman, Wash., on the direct thermal reduction of magnesium from magnesite.

MANGANESE—Stockpile purchases by the Procurement Division of the Treasury Department under the Strategic Materials Act continued in 1940 and to date total approximately 90,000 long tons of high-grade metallurgical ore, obtained largely from Cuba, the Philippines, and other foreign sources. After midyear government acquisition of manganese ore was transferred to the Metals Reserve Co. to permit the buying of larger tonnages and greater flexibility in purchasing procedure. This agency has contracted for approximately 2,000,000 tons of foreign and domestic ore, but deliveries have been small. One contract with the Anaconda Copper Mining Co. calls for delivery of 240,000 tons of high-grade nodules over a period of three years. The company is reported to be spending about $1,000,000 on construction and equipment. The ore will be stored at Anaconda, Mont.

The price of manganese ore was high, and the trend was upward throughout the year. Shipping conditions explained most of the rise.

Despite the greatly enhanced price, domestic production of manganese ore was small, having increased only to about 40,000 tons from 29,307 in 1939. The government purchasing program has stimulated interest in developing mines and prospects, but this will not be evident in deliveries until 1941 and 1942.

Imports were at a high rate and for the first eleven months of 1940 totaled 1,143,225 tons, compared with 583,148 tons for the same period in 1939. Although some of this ore moved into government stockpiles, industry maintained its stocks at more than a year's supply.

MERCURY—The outstanding feature of the mercury industry in 1940 was the rapid rise in domestic production under high prices to a point where, temporarily at least, domestic mines were able to supply full domestic requirements and have a surplus for exportation. Production increased from approximately 1,800 flasks in January to 3,600 in September and October and probably exceeded 36,000 flasks for the year. Consumption in 1940 totaled possibly 27,000 to 28,000 flasks. Imports for consumption in the first eleven months of 1940 were only 171 flasks; general imports were 1,861 flasks and exports 9,049 flasks. The United Kingdom and Japan were active buyers. Early in July, after being placed under licensing control, exports dropped immediately; those to Japan ceased. Despite the large exports, domestic stocks were well maintained. Domestic prices rose from $142 to $148 per flask to slightly over $200 in June, then dropped to $164 to $166 at the end of the year.

MOLYBDENUM—Domestic production of molybdenum was higher in 1940, owing to increased byproduct output from copper mines at Bingham, Chino, and Miami. Shipments, however, were lower, owing to restricted exports, and stocks were accumulated at producing plants. The principal producer, the Climax Molybdenum Co., operated its mine and 12,000-ton flotation mill continuously but not at capacity, producing 22,600,000 lb. of molybdenum, an increase of about 800,000 lb. over 1939.

Exports of molybdenum ore and concentrates from the United States during the first eleven months of 1940 were 12,600,456 lb., compared with 37,372,912 lb. during the first eleven months of 1939. There were no imports in 1940.

PLATINUM METALS—Production of platinum metals in the chief producing countries apparently was maintained at about the 1939 rate.

Domestic imports of platinum metals declined to 166,075 oz. during the first eleven months of 1940 from 306,627 oz. during the entire year 1939. Note-

worthy was the decrease in imports of iridium, which were only 237 oz., compared with 6,363 oz. in 1939.

The quoted price of refined platinum dropped from $40 an ounce early in the year to $36 at the close. Palladium was quoted at $24 throughout the year. The price of iridium fluctuated widely between $125 at the beginning of 1940 and $275 at the end of the year. The greatly increased price of iridium was attributed chiefly to a temporary scarcity in the United States resulting from cessation of supplies from the U.S.S.R., which normally contributes over 40 percent of our imports.

TUNGSTEN—Production and consumption of tungsten made considerable advances in 1940 and total imports for the year were the highest recorded since the World War. A large part of the ore imported was for government account, but total supplies available to industry were adequate for requirements. Industry stocks declined during the last quarter of 1940 but showed a slight increase for the year.

The government stockpiling program made little progress during the first half of 1940 because industry absorbed nearly all ore offered. In June, however, the government was fortunate in making a large purchase of Chinese ore, which apparently had been secretly stored in the Orient. Shipment was made from Indo-China after some delay in obtaining clearance from the new French Government. Late in the year a loan of $30,000,000 was made to the Chinese Government by the Import-Export Bank, to be repaid in part by deliveries of tungsten concentrates during the years 1941 to 1946. Subsequently, another loan of $60,000,000 was arranged, to be repaid by sales of various metals or ores, including tungsten, in the United States.

Imports for eleven months totaled 7,000 tons of ore, 3,000 of which came from China. Movement of Chinese ore was hampered by Japanese activity throughout 1940. With the coast line blockaded, shipments were made through Indo-China via Haiphong and Saigon, but this route was cut off by the arrival of the Japanese. After the reopening of the Burma Road on Oct. 17, tungsten ore began to move out via Rangoon. United States imports from South America were very large in 1940.

Domestic production in 1940 is estimated at about 4,600 short tons (60 percent WO_4 basis). New mills were built and additional capacity was added that will increase tungsten production in 1941.

A plant has been erected in the free-trade zone of New York to clean impure tungsten ores from South America and elsewhere. The plant, which will produce concentrates meeting government specifications, is now operating and making deliveries.

VANADIUM—The apparent consumption of vanadium was greater in 1940 than in 1939. Imports, all from Peru, during the first eleven months amounted to 19,873 short tons containing 3,996,511 lb. of V_2O_5, compared with 12,667 tons of ore for the same period in 1939.

Domestic production increased to about 2,500,000 lb. in 1940. Virtually all output was made in the Paradox Valley area of Montrose County, Colo., where the United States Vanadium Co. continued to operate its 260-ton roasting, leaching, and precipitation plant at Uravan. The recovery of uranium was initiated at the plant in 1940. The Vanadium Corporation of America reopened its plant at Naturita about mid-year. The North Continent Mines, Inc., is treating vanadium ores at a new mill near Cedar, San Miguel County.

Nominal quotations for ore remained unchanged throughout the year at 27.5c. per pound of contained V_2O_5.

YEARLY AVERAGE PRICES MISCELLANEOUS METALS

Year	Aluminum	Antimony	Cadmium	Quicksilver	Platinum
1940	18.691	14.000	(a)79.920	176.865	37.924
1939	20.000	12.359	(a)59.180	103.940	36.748
1938	20.000	12.349	98.037	75.469	35.901
1937	19.917	15.355	122.335	90.180	51.773
1936	20.000	12.240	97.789	79.917	42.926
1935	20.000	13.616	70.491	71.992	34.150
1934	23.300	8.901	55.000	73.865	36.465
1933	23.300	6.528	55.000	59.227	30.993
1932	23.300	5.592	55.000	57.925	36.455
1931	23.300	6.720	56.010	87.351	35.665
1930	23.787	7.667	(b)	115.009	45.358
1929	24.300	8.956	(b)	122.145	67.655

Quotations for aluminum, antimony, and cadmium in cents per pound; quicksilver in dollars per flask of 76 pounds; platinum, refined, in dollars per troy ounce. (a) Commercial sticks, producers' quotation. (b) Not averaged by *E. & M. J.*

ZINC

(*Continued from page* 47)

is required, and not until the second quarter of 1941 will this increase in smelting capacity be available, and not until late summer in 1941 can it conceivably be in substantially full operation.

Meanwhile, the price situation seems to have been kept well in hand. In spite of the fact that a seemingly unavoidable movement by users to cover requirements far ahead had raised the price to 7¼c. before the end of September, it is still 7¼c. as this article is written, although stocks of slab zinc have been reduced to the second lowest point on record.

The American Zinc Institute, representing the entire zinc industry, has worked closely and continuously with the Advisory Commission to the Council of National Defense in connection with the problem of anticipated production and consumption of zinc during 1941 and 1942. From these studies it is understood that, with the additional production which is expected to be available during the latter part of the second quarter and the early part of the third quarter of 1941, and using the best estimates which can be projected for all normal domestic uses of all grades of zinc, together with National Defense requirements as estimated by the Army and Navy, production and requirements of zinc during the full year of 1941 will be in approximate balance. Due allowance has been made in these estimates for a reasonable volume of exports to Great Britain.

A high degree of cooperation between the consumers and producers of zinc will, of course, be necessary because, during the early part of 1941, the situation will probably be tight, particularly in view of the fact that stocks of metal in the hands of producers are low and consumers are thinking in terms of high production schedules. On the other hand, outstanding stocks of metal in the hands of consumers are understood to be large. As the year progresses, the situation should improve. With the cooperation of consumers of zinc and of products in which zinc is used, the producers feel that *actual* requirements can be taken care of.

Reviewing the zinc situation in these columns a year ago, I wrote—"Forecasting today is more than hazardous. . . . Governing the prospects of domestic business are the developments indirectly associated with the intensity and unpredictable duration of the war in Europe." Every reader of this column will appreciate the continuing truth of these statements.

GOLD

(*Continued from page* 43)

linking the total volume of money to the supply of gold an automatically "sound" monetary system seemed assured. As indicated in these pages last year, however, the links between gold and the money supply have been progressively weakening owing to the inability of monetary systems tied rigidly to gold to cope with shifting economic conditions, and the trend has been towards conscious, independent monetary management. Under the new techniques the money supply can be better adjusted to economic needs than if gold alone was the arbiter.

The foregoing ideas, unfortunately, form the basis of much current thinking concerning gold. They contribute to misunderstanding of the real nature of the gold problem and the significance of the gold standard. The gold standard was essentially not a domestic but an international monetary system. Each of the countries adhering to the standard had its own monetary system, with bank deposits, paper currency, and subsidiary coins satisfying the domestic needs for money. Before the World War, gold coin was permitted to circulate locally to some extent, but this was unnecessary, and after the War the practice was abandoned by every major country except the United States in order that the gold could be concentrated in the hands of the monetary authority. This was done because gold was an international money and because it was limited in supply. Dollars, sterling, or francs could be created as needed, but they were not readily acceptable outside the United States, the United Kingdom, or France. Gold was. Each of the countries adhering to the gold standard permitted the free transfer of gold to or from its shores; each stood ready to pay out or receive gold in unlimited amounts at a fixed rate of exchange against its domestic money; and none interfered to an appreciable extent with the free and non-discriminatory conduct of financial and business transactions. The gold standard was thus a true international monetary system, based on freedom of transfer. As such it was closely tied in with the functioning of the free enterprise economy with which it had developed.

That this sort of monetary system should be regarded with disfavor in Nazi German circles is assuredly not surprising. Gold, to the Nazis, is the symbol of a way of life which they abhor and which, in the territories under their control, they are destroying. Chancellor Hitler, in his speech of Dec. 10 last, voiced his point of view in the following terms:

"When I came into power it wasn't malice on my part that prompted me to turn from the gold standard, for we no longer had any gold. And I wasn't unhappy about it either. Our economic structure is an entirely different one. For us gold is no factor of value, but a device for subjugating and lording it over peoples. Two worlds are in conflict, two philosophies of life. They say we should help to keep up the gold standard—of course, for they have gold and we have none. Should we go to pieces, I asked, because we have no gold? Our capacity for work is our gold, our capital, and with it we will defeat the entire world. I built up my entire economy on the concept of work. Those who have gold have failed completely."

A more measured statement, however, was contained in a speech on the economic reorganization of Europe made last July by Dr. Walther Funk, German minister of National Economy and President of the Reichsbank:

"The gold problem is essentially a problem for the United States of America. As a basis for European currencies, gold will never in the future play a part, for a currency is not dependent on its cover but on the value given to it by the State, i.e. by the economy regulated by the State. The clearing system makes gold no longer indispensable for monetary and payment purposes within the clearing. Whether gold can still be regarded as a suitable medium of the settlement of marginal balances outside the clearing system, i.e. for free trade and payment transactions, is quite another matter; but we shall never act on a currency policy involving us in any kind of dependence on gold, for it is not possible to bind one's self to a medium the value of which one cannot fix one's self."

The Chancellor's tirade betrays the emotional basis of the German attitude towards gold. The statement of Dr. Funk provides this attitude with its economic content. Regarded solely from the latter standpoint, the German position cannot be considered untenable. As noted earlier, gold does not strengthen the value or facilitate the functioning of a local currency. And, as Dr. Funk points out, the development of the clearing system has made it possible to do away with gold in the conduct of international business. There is thus no technical reason why a victorious Germany and its satellites would be compelled to reestablish the gold standard in the post-war world. On the other hand, the statement does not rule out completely the use of gold on an opportunistic basis for the settlement of international balances with countries outside the German clearing system or perhaps for certain types of transactions between countries within the system. In other words, Germany would continue to use gold so long as it was convenient and in her interest to do so. How long would this be?

It would clearly be in the German interest to encourage or facilitate the continuing use of gold so long as Germany itself possessed any considerable stock of the metal. At the outbreak of the war, recorded German gold holdings were negligible, but estimates which took account of unreported reserves placed the figure at about $150,000,000. Since that time, the German gold stock has undoubtedly been increased substantially through conquest and may now be as high as $2,000,000,000. If a victorious Germany, holding this gold stock, should abruptly refuse to deal in gold following the termination of hostilities, it is highly probable that similar action would immediately be taken by the United States. This country would be left with a tremendous sterile gold pile, but Germany would also hold a considerable quantity of the metal which it would much prefer to convert into commodities, if possible. Under such conditions the wise German policy would be to resume the use of gold for international settlements pending reduction of its own stake in the metal to a low level. That is, while Germany would both buy and sell gold, commercial and financial policy would be aimed at reducing rather than increasing the gold stock, ultimate exhaustion of which would set the stage for final and complete demonetization of gold by Germany.

Such a policy could succeed only if the United States should continue to buy gold in unlimited quantities at $35 an ounce from all comers and to insist upon maintaining a commodity export surplus instead of an import balance. It is possible that it might do so. On the other hand, the country might awake to the realization that it was foolhardy to take gold from an actual or potential enemy in exchange for goods. It is even conceivable that this country would see the wisdom of attempting to exchange a large part of its gold hoard for commodities or equipment useful for defense or for the peaceful expansion of industrial production in the United States. Unfortunately, the possibility that we would be able to find buyers for our gold is rather remote. The demand for commodities after the cessation of hostilities will be intense, and foreign countries generally will be much more desirous of selling gold than of buying it. There is no reason, however, why the United States should buy gold from any country to which it does not wish to render assistance. A modification of the gold-buying policy of the United States, therefore, would open the way to defeating, at least in part, the gold policy that a victorious Germany would be likely to adopt for a time following the cessation of hostilities.

E & M J METAL PRICES FOR 1940 • BY DAYS

Including Monthly Highs and Lows and Monthly Averages

JANUARY

Jan.	Copper, Electrolytic Domestic	Copper, Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
2	12.275	12.375	48.750	5.50	34.750	5.75
3	12.275	12.375	48.000	5.50	34.750	5.75
4	12.275	12.400	47.500	5.50	34.750	5.75
5	12.275	12.375	47.500	5.50	34.750	5.75
6	12.275	12.375	47.500	5.50	.....	5.75
8	12.275	12.400	47.750	5.50	34.750	5.75
9	12.275	12.375	48.125	5.50	34.750	5.75
10	12.275	12.275	48.000	5.50	34.750	5.75
11	12.275	12.275	47.500	5.50	34.750	5.75
12	12.100	12.300	47.125	5.50	34.750	5.75
13	12.275	12.400	47.250	5.50	.....	5.75
15	12.025@12.275	12.200	47.250	5.50	34.750	5.75
16	12.025@12.275	12.225	47.000	5.50	34.750	5.75
17	12.025@12.275	12.225	46.875	5.50	34.750	5.75
18	12.025	12.150	46.500	5.50	34.750	5.75
19	11.900	12.075	46.000	5.50	34.750	5.50
20	11.775	11.950	45.875	5.50	.....	5.50
22	11.775	11.700	45.250	5.50	34.750	5.50
23	11.675	11.525	45.125	5.50	34.750	5.50
24	11.775	11.450	45.250	5.50	34.750	5.50
25	11.400@11.775	11.450	45.375	5.50	34.750	5.50
26	11.400	11.450	45.625	5.50	34.750	5.50
27	11.400	11.450	45.750	5.50	.....	5.50
29	11.400	11.400	46.000	5.25	34.750	5.50
30	11.400	11.400	45.875	5.25	34.750	5.50
31	11.400	11.400	45.625	5.25	34.750	5.50
High	**12.275**	**12.400**	**48.750**	**5.500**	**34.750**	**5.750**
Low	**11.400**	**11.400**	**45.125**	**5.250**	**34.750**	**5.500**
Average	**11.954**	**11.999**	**46.707**	**5.471**	**34.750**	**5.644**

FEBRUARY

Feb.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.350	11.450	45.500	5.25	34.750	5.500
2	11.350	11.450	45.000	5.25	34.750	5.500
3	11.150	11.450	45.000	5.25	.....	5.500
5	11.175	11.375	45.250	5.25	34.750	5.500
6	11.150	11.400	45.125	5.25	34.750	5.500
7	11.025	11.400	45.125	5.00	34.750	5.500
8	11.025	11.325	45.000	5.00	34.750	5.500
9	11.025	11.350	45.250	5.00	34.750	5.500
10	11.025	11.350	45.375	5.00	.....	5.500
12	Holiday	11.200	Holiday	Holiday	Holiday	Holiday
13	11.025	11.325	45.875	5.00	34.750	5.500
14	11.025	11.300	45.625	5.00	34.750	5.500
15	11.025	11.350	45.125	5.00	34.750	5.500
16	11.025	11.400	45.125	5.00	34.750	5.500
17	11.025	11.425	45.125	5.00	.....	5.500
19	11.025	11.450	45.375	5.00	34.750	5.500
20	11.050	11.450	46.125	5.00	34.750	5.500
21	11.275	11.625	46.325	5.00	34.750	5.500
22	Holiday	11.675	Holiday	Holiday	Holiday	Holiday
23	11.275	11.700	46.125	5.00	34.750	5.500
24	11.275	11.700	46.125	5.00	.....	5.500
26	11.275	11.700	47.500	5.00	34.750	5.525
27	11.275	11.700	48.125	5.00	34.750	5.750
28	11.275	11.650	47.625	5.25	34.750	5.750
29	11.275	11.575	47.750	5.25	34.750	5.750
High	**11.350**	**11.700**	**48.125**	**5.250**	**34.750**	**5.750**
Low	**11.025**	**11.200**	**45.000**	**5.000**	**34.750**	**5.500**
Average	**11.148**	**11.471**	**45.851**	**5.076**	**34.750**	**5.534**

MARCH

Mar.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.275	11.525	47.500	5.25	34.750	5.75
2	11.275	11.525	47.375	5.25	.....	5.75
4	11.275	11.550	47.250	5.25	34.750	5.75
5	11.275	11.550	47.500	5.25	34.750	5.75
6	11.275	11.575	47.625	5.25	34.750	5.75
7	11.275	11.575	47.875	5.25	34.750	5.75
8	11.275	11.625	47.750	5.25	34.750	5.75
9	11.275	11.625	49.000	5.25	.....	5.75
11	11.275	11.600	49.000	5.25	34.750	5.75
12	11.275	11.550	48.750	5.25	34.750	5.75
13	11.275	11.550	48.125	5.25	34.750	5.75
14	11.275	11.500	47.375	5.25	34.750	5.75
15	11.275	11.500	47.125	5.25	34.750	5.75
16	11.275	11.450	47.000	5.25	.....	5.75
18	11.025	11.450	46.500	5.25	34.750	5.75
19	11.025	11.425	46.500	5.15	34.750	5.75
20	11.025	11.400	46.625	5.15	34.750	5.75
21	11.025	11.325	46.750	5.15	34.750	5.75
22	11.025	11.200	46.750	5.15	34.750	5.75
23	11.025	11.200	46.750	5.15	.....	5.75
25	11.025	11.200	46.625	5.15	34.750	5.75
26	11.025	11.175	46.000	5.15	34.750	5.75
27	11.025	11.150	45.625	5.05	34.750	5.75
28	11.025	11.125	45.750	5.05	34.750	5.75
29	11.025	11.100	45.625	5.05	34.750	5.75
30	11.025	11.125	45.300	5.05	.....	5.75
High	**11.275**	**11.625**	**49.000**	**5.250**	**34.750**	**5.750**
Low	**11.025**	**11.100**	**45.300**	**5.050**	**34.750**	**5.750**
Average	**11.160**	**11.407**	**47.079**	**5.192**	**34.750**	**5.750**

APRIL

April	Copper, Electrolytic Domestic	Copper, Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
1	10.900	11.100	44.750	5.05	34.750	5.75
2	10.900	11.075	45.750	5.00	34.750	5.75
3	10.900	11.050	45.625	5.00	34.750	5.75
4	10.900	11.050	45.500	5.00	34.750	5.75
5	10.975	11.000	45.500	5.00	34.750	5.75
6	11.025	11.100	45.750	5.00	.....	5.75
8	11.025	11.125	46.000	5.00	34.750	5.75
9	11.150	11.375	47.250	5.00	34.750	5.75
10	11.275	11.425	47.500	5.10	34.750	5.75
11	11.275	11.450	47.500	5.10	34.750	5.75
12	11.275	11.425	47.250	5.10	34.750	5.75
13	11.275	11.425	46.500	5.10	.....	5.75
15	11.275	11.350	46.500	5.10	34.750	5.75
16	11.275	11.375	47.250	5.10	34.750	5.75
17	11.275	11.325	47.500	5.10	34.750	5.75
18	11.150	11.350	47.500	5.10	34.750	5.75
19	11.100	11.350	47.375	5.10	34.750	5.75
20	11.100	11.325	47.125	5.10	.....	5.75
22	11.025	11.325	47.125	5.10	34.750	5.75
23	11.025	11.275	47.325	5.10	34.750	5.75
24	11.025	11.250	47.375	5.10	34.750	5.75
25	11.025	11.275	47.500	5.10	34.750	5.75
26	11.025	11.250	47.500	5.10	34.750	5.75
27	11.025	11.275	47.625	5.10	.....	5.75
29	11.025	11.200	47.500	5.10	34.750	5.75
30	11.025	11.175	47.125	5.10	34.750	5.75
High	**11.275**	**11.450**	**47.625**	**5.100**	**34.750**	**5.750**
Low	**10.900**	**11.000**	**44.750**	**5.000**	**34.750**	**5.750**
Average	**11.087**	**11.258**	**46.815**	**5.071**	**34.750**	**5.750**

MAY

May	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.025	11.050	47.250	5.10	34.750	5.75
2	10.900	11.000	47.375	5.10	34.750	5.75
3	10.900	11.025	47.375	5.10	34.750	5.75
4	10.900	11.000	47.125	5.10	.....	5.75
6	10.900	11.025	47.125	5.00	34.750	5.75
7	10.850	11.025	47.500	5.00	34.750	5.75
8	10.850	10.950	47.625	5.00	34.750	5.75
9	10.825	10.900	47.625	5.00	34.750	5.75
10	11.150	11.000	53.500	5.00	34.750	5.75
11	11.275	11.250	54.500	5.00	.....	5.75
13	11.275	11.325	54.000	5.00	34.750	5.75
14	11.150@11.275	11.325	52.500	5.00	34.750	5.75
15	11.150@11.275	11.250	51.500	5.00	34.750	5.75
16	11.275	11.325	52.500	5.00	34.750	5.75
17	11.150@11.275	11.325	53.500	5.00	34.750	5.75
18	11.150	11.300	54.000	5.00	.....	5.75
20	11.150	11.300	54.000	5.00	35.000	5.75
21	11.025	11.275	53.875	5.00	35.000	5.75
22	11.025	11.250	53.875	5.00	35.000	5.75
23	11.025	11.275	53.500	5.00	35.125	5.75
24	11.025	11.275	53.000	5.00	35.250	5.875
25	11.150	11.250	52.700	5.00	.....	6.00
27	11.175	11.300	52.500	5.00	35.375	6.00
28	11.150	11.250	53.500	5.00	35.625	6.00
29	11.150	11.275	53.875	5.00	35.625	6.00
30	Holiday	11.300	Holiday	Holiday	Holiday	Holiday
31	11.275	11.325	55.000	5.00	35.125	6.00
High	**11.275**	**11.325**	**55.000**	**5.100**	**35.625**	**6.000**
Low	**10.825**	**10.900**	**47.125**	**5.000**	**34.750**	**5.750**
Average	**11.079**	**11.191**	**51.570**	**5.015**	**34.949**	**5.903**

JUNE

June	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.275	11.325	54.750	5.00	.....	6.00
3	11.275	11.400	55.000	5.00	35.250	6.125
4	11.275	11.425	54.750	5.00	34.750	6.25
5	11.275	11.375	54.250	5.00	34.750	6.25
6	11.275	11.375	53.750	5.00	34.750	6.25
7	11.275	11.425	54.375	5.00	34.750	6.25
8	11.275	11.425	54.500	5.00	.....	6.25
10	11.275	11.350	55.000	5.00	34.750	6.25
11	11.275	11.425	56.500	5.00	35.000	6.25
12	11.275	11.425	57.000	5.00	35.000	6.25
13	11.275	11.425	58.000	5.00	35.000	6.25
14	11.275	11.400	58.000	5.00	35.000	6.25
15	11.275	11.400	57.250	5.00	.....	6.25
17	11.275	11.425	56.250	5.00	34.750	6.25
18	11.025@11.275	11.325	52.125	5.00	34.750	6.25
19	11.025@11.275	11.200	53.250	5.00	34.750	6.25
20	10.900@11.025	11.100	54.750	5.00	34.750	6.25
21	10.900@11.025	11.050	55.000	5.00	34.750	6.25
22	10.900@11.025	11.050	54.500	5.00	.....	6.25
24	10.900@11.025	10.950	53.750	5.00	34.750	6.25
25	10.900	10.950	52.250	5.00	34.750	6.25
26	10.775@10.900	10.925	52.250	5.00	34.750	6.25
27	10.775	10.775	53.000	5.00	34.750	6.25
28	10.775@10.900	10.750	52.500	5.00	34.750	6.25
29	10.775@10.900	10.725	52.700	5.00	.....	6.25
High	**11.275**	**11.425**	**58.000**	**5.000**	**35.250**	**6.250**
Low	**10.775**	**10.725**	**52.125**	**5.000**	**34.750**	**6.000**
Average	**11.128**	**11.216**	**54.618**	**5.000**	**34.825**	**6.235**

E & M J METAL PRICES FOR 1940 • BY DAYS

Including Monthly Highs and Lows and Monthly Averages

JULY

July	Copper Electrolytic Domestic	Copper Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
1	10.775@10.900	10.650	52.250	5.00	34.750	6.25
2	10.725	10.650	52.250	5.00	34.750	6.25
3	10.650@10.775	10.600	52.000	5.00	34.750	6.25
4	Holiday	10.450	Holiday	Holiday	Holiday	Holiday
5	10.675	10.450	52.000	5.00	34.750	6.25
6	10.525@10.650	10.450	52.000	5.00	.....	6.25
8	10.525@10.650	10.450	52.000	5.00	34.750	6.25
9	10.550	10.400	51.500	5.00	34.750	6.25
10	10.650	10.400	51.500	5.00	34.750	6.25
11	10.650	10.275	51.375	5.00	34.750	6.25
12	10.650	10.250	51.250	5.00	34.750	6.25
13	10.650	10.250	51.250	5.00	.....	6.25
15	10.525@10.650	10.200	51.250	5.00	34.750	6.25
16	10.525	10.200	51.000	5.00	34.750	6.25
17	10.525	10.200	51.000	5.00	34.750	6.25
18	10.400@10.525	10.000	51.000	5.00	34.750	6.25
19	10.400@10.525	10.050	51.000	5.00	34.750	6.25
20	10.400@10.525	10.050	51.000	5.00	.....	6.25
22	10.275@10.400	10.025	51.000	5.00	34.750	6.25
23	10.275	9.950	51.250	5.00	34.750	6.25
24	10.275	9.950	51.375	5.00	34.750	6.25
25	10.275	9.900	51.500	5.00	34.750	6.25
26	10.400	9.875	51.625	5.00	34.750	6.25
27	10.425	9.875	51.625	5.00	.....	6.25
29	10.575	9.850	52.000	5.00	34.750	6.25
30	10.775	9.850	52.500	5.00	34.750	6.25
31	11.025	9.850	52.875	5.00	34.750	6.25
High	**11.025**	**10.650**	**52.875**	**5.000**	**34.750**	**6.250**
Low	**10.275**	**9.850**	**51.000**	**5.000**	**34.750**	**6.250**
Average	**10.564**	**10.189**	**51.591**	**5.000**	**34.750**	**6.250**

AUGUST

Aug.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.025	9.825	52.625	5.00	34.750	6.25
2	10.775@11.025	9.850	52.125	5.00	34.750	6.25
3	10.775@11.025	9.850	52.000	5.00	.....	6.25
5	10.775@11.025	9.850	52.250	5.00	34.750	6.25
6	10.650@10.775	9.850	52.250	4.85	34.750	6.25
7	10.525	9.850	52.125	4.85	34.750	6.25
8	10.525	9.850	51.875	4.85	34.750	6.25
9	10.525	9.850	51.750	4.75	34.750	6.25
10	10.525	9.850	51.750	4.75	.....	6.25
12	10.525	9.825	51.750	4.75	34.750	6.25
13	10.525	9.850	51.000	4.75	34.750	6.25
14	10.525	9.875	50.750	4.75	34.750	6.25
15	10.525	9.850	50.750	4.75	34.750	6.50
16	10.650	9.850	50.750	4.75	34.750	6.50
17	10.650	9.850	50.750	4.75	.....	6.50
19	10.650	9.850	50.750	4.75	34.750	6.50
20	10.775	9.850	50.625	4.75	34.750	6.50
21	10.775	9.875	50.625	4.90	34.750	6.50
22	10.775	9.875	50.625	4.90	34.750	6.50
23	10.775	9.850	50.625	4.90	34.750	6.50
24	10.775	9.850	50.625	4.90	.....	6.50
26	10.775	9.850	50.625	4.90	34.750	6.50
27	10.775	9.850	50.625	4.90	34.750	6.50
28	10.775	9.850	50.625	4.90	34.750	6.50
29	10.775	9.850	50.500	4.90	34.750	6.50
30	10.775	9.850	50.500	4.90	34.750	6.50
31	10.775	9.850	50.500	4.90	.....	6.50
High	**11.025**	**9.875**	**52.625**	**5.000**	**34.750**	**6.500**
Low	**10.525**	**9.825**	**50.500**	**4.750**	**34.750**	**6.250**
Average	**10.708**	**9.851**	**51.176**	**4.854**	**34.750**	**6.389**

SEPTEMBER

Sept.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
2	Holiday	9.850	Holiday	Holiday	Holiday	Holiday
3	10.775	9.850	50.500	4.90	34.750	6.50
4	10.775	9.875	50.500	4.90	34.750	6.50
5	10.775@11.275	9.850	50.375	4.90	34.750	6.675
6	11.275	9.850	50.250	4.90	34.750	6.85
7	11.275	9.850	50.250	4.90	.....	6.85
9	11.150@11.275	9.850	50.250	4.90	34.750	6.85
10	11.150	9.850	50.125	4.90	34.750	6.85
11	11.025	9.850	50.100	4.90	34.750	6.85
12	11.025	9.850	50.050	4.90	34.750	6.85
13	11.150	9.850	50.050	4.90	34.750	6.85
14	11.150	9.850	50.050	4.90	.....	6.85
16	11.150	9.800	50.050	4.90	34.750	6.85
17	11.150	9.850	50.050	4.90	34.750	6.85
18	11.150@11.275	9.850	50.050	4.90	34.750	6.85
19	11.275	9.850	50.050	4.90	34.750	6.85
20	11.275	9.850	50.050	4.90	.....	6.85
21	11.275	9.850	50.050	4.90	.....	6.85
23	11.275	9.850	50.075	5.00	34.750	7.00
24	11.775	9.850	50.100	5.00	34.750	7.25
25	11.775	9.850	50.375	5.00	34.750	7.25
26	11.775	9.850	50.500	5.00	34.750	7.25
27	11.775	9.850	51.500	5.00	34.750	7.25
28	11.775	9.850	51.500	5.00	.....	7.25
30	11.775	9.850	51.500	5.00	34.750	7.25
High	**11.775**	**9.875**	**51.500**	**5.000**	**34.750**	**7.250**
Low	**10.775**	**9.800**	**50.050**	**4.900**	**34.750**	**6.500**
Average	**11.296**	**9.849**	**50.348**	**4.929**	**34.750**	**6.920**

OCTOBER

Oct.	Copper Electrolytic Domestic	Copper Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
1	11.775	9.850	51.500	5.00	34.750	7.25
2	11.775	9.850	51.375	5.00	34.750	7.25
3	11.775	9.950	51.250	5.00	34.750	7.25
4	11.775	10.000	51.000	5.00	34.750	7.25
5	11.775	10.075	51.000	5.00	.....	7.25
7	11.775	10.175	51.000	5.00	34.750	7.25
8	11.775	10.200	51.000	5.00	34.750	7.25
9	11.775	10.200	51.375	5.00	34.750	7.25
10	11.775	10.200	51.875	5.25	34.750	7.25
11	11.775	10.425	51.875	5.25	34.750	7.25
12	Holiday	10.425	Holiday	Holiday	Holiday	Holiday
14	11.775	10.200	51.875	5.25	34.750	7.25
15	11.775	10.450	51.875	5.25	34.750	7.25
16	11.775	10.450	51.875	5.50	34.750	7.25
17	11.825	10.600	51.625	5.50	34.750	7.25
18	11.875	10.725	51.625	5.50	34.750	7.25
19	11.775	10.700	51.625	5.50	.....	7.25
21	12.100	10.950	51.625	5.50	34.750	7.25
22	12.125	10.925	51.500	5.50	34.750	7.25
23	11.875	10.825	51.625	5.50	34.750	7.25
24	11.900	10.825	51.625	5.50	34.750	7.25
25	11.825	10.750	51.500	5.50	34.750	7.25
26	11.775	10.700	51.500	5.50	.....	7.25
28	11.800	10.725	51.500	5.50	34.750	7.25
29	11.950	10.450	51.500	5.50	34.750	7.25
30	11.775	10.600	51.375	5.50	34.750	7.25
31	11.800	10.550	51.250	5.50	34.750	7.25
High	**12.125**	**10.950**	**51.875**	**5.500**	**34.750**	**7.250**
Low	**11.775**	**9.850**	**51.000**	**5.000**	**34.750**	**7.250**
Average	**11.826**	**10.436**	**51.490**	**5.308**	**34.750**	**7.250**

NOVEMBER

Nov.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.775	10.350	51.125	5.50	34.750	7.25
2	11.775	10.325	51.000	5.50	.....	7.25
4	11.850	10.450	51.000	5.50	34.750	7.25
5	Holiday	10.200	Holiday	Holiday	Holiday	Holiday
6	11.775	10.225	50.875	5.65	34.750	7.25
7	11.850	10.000	50.875	5.65	34.750	7.25
8	11.800	10.300	51.000	5.75	34.750	7.25
9	11.785	10.300	51.000	5.80	.....	7.25
11	Holiday	9.950	Holiday	Holiday	Holiday	Holiday
12	11.800	10.050	50.750	5.80	34.750	7.25
13	11.800	9.950	50.750	5.80	34.750	7.25
14	11.775	10.200	50.625	5.80	34.750	7.25
15	11.900	10.200	50.500	5.80	34.750	7.25
16	11.775	10.075	50.500	5.80	.....	7.25
18	11.800	9.950	50.375	5.80	34.750	7.25
19	11.850	9.950	50.300	5.80	34.750	7.25
20	11.775	9.950	50.250	5.80	34.750	7.25
21	Holiday	10.000	Holid y	Holiday	Holiday	Holiday
22	11.800	9.950	50.375	5.80	34.750	7.25
23	11.775	9.950	50.375	5.80	.....	7.25
25	11.775	9.975	50.250	5.80	34.750	7.25
26	11.775	9.950	50.300	5.80	34.750	7.25
27	11.825	9.950	50.300	5.80	34.750	7.25
28	11.785	10.050	50.250	5.65	34.750	7.25
29	11.800	9.950	50.250	5.65	34.750	7.25
30	11.775	9.975	50.250	5.65	.....	7.25
High	**11.900**	**10.450**	**51.125**	**5.800**	**34.750**	**7.250**
Low	**11.775**	**9.950**	**50.250**	**5.500**	**34.750**	**7.250**
Average	**11.800**	**10.084**	**50.577**	**5.726**	**34.750**	**7.250**

DECEMBER

Dec.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
2	11.775	10.250	50.200	5.50	34.750	7.25
3	11.775	10.300	50.200	5.50	34.750	7.25
4	11.875	10.200	50.200	5.50	34.750	7.25
5	11.800	10.200	50.200	5.50	34.750	7.25
6	11.825	10.300	50.100	5.50	34.750	7.25
7	11.825	10.250	50.100	5.50	.....	7.25
9	11.800	10.200	50.075	5.50	34.750	7.25
10	11.800	10.200	50.050	5.50	34.750	7.25
11	11.775	10.200	50.050	5.50	34.750	7.25
12	11.850	10.200	50.050	5.50	34.750	7.25
13	11.775	10.200	50.050	5.50	34.750	7.25
14	11.775	10.250	50.050	5.50	.....	7.25
16	11.775	10.450	50.050	5.50	34.750	7.25
17	11.875	10.300	50.050	5.50	34.750	7.25
18	11.875	10.450	50.100	5.50	34.750	7.25
19	11.775	10.350	50.100	5.50	34.750	7.25
20	11.825	10.400	50.100	5.50	34.750	7.25
21	11.775	10.375	50.100	5.50	.....	7.25
23	11.775	10.375	50.100	5.50	34.750	7.25
24	11.775	10.350	50.100	5.50	34.750	7.25
25	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
26	11.775	10.350	50.100	5.50	34.750	7.25
27	11.825	10.325	50.100	5.50	34.750	7.25
28	11.775	10.325	50.100	5.50	.....	7.25
30	11.800	10.325	50.100	5.50	34.750	7.25
31	11.775	10.200	50.100	5.50	34.750	7.25
High	**11.875**	**10.450**	**50.200**	**5.500**	**34.750**	**7.250**
Low	**11.775**	**10.200**	**50.050**	**5.500**	**34.750**	**7.250**
Average	**11.802**	**10.293**	**50.101**	**5.500**	**34.750**	**7.250**

E&MJ
Annual Average Metal Prices 1898-1940

Year	Copper (a) Electrolytic, Refinery	Tin, (b) New York	Lead Common, New York	Silver New York	Zinc, Prime Western (d) E. St. Louis
1898	12.03	15.70	3.78	58.260	4.57
1899	16.67	25.12	4.47	59.580	5.75
1900	16.19	29.90	4.37	61.330	4.39
1901	16.11	16.74	4.33	58.950	4.07
1902	11.626	26.79	4.069	52.160	4.84
1903	13.235	28.09	4.237	53.570	5.191
1904	12.823	27.99	4.309	57.221	4.931
1905	15.590	31.358	4.707	60.352	5.730
1906	19.278	39.819	5.657	66.791	6.048
1907	20.004	38.166	5.325	65.237	5.812
1908	13.208	29.465	4.200	52.864	4.578
1909	12.982	29.725	4.273	51.502	5.352
1910	12.738	34.123	4.446	53.486	5.370
1911	12.376	42.281	4.420	53.340	5.608
1912	16.341	46.096	4.471	60.835	6.799
1913	15.269	44.252	4.370	59.791	5.504
1914	13.602	34.301 (c)	3.862	54.811	5.061
1915	17.275	38.590	4.673	49.684	13.054
1916	27.202	43.480	6.858	65.661	12.634
1917	27.180	61.802	8.787	81.417	8.813
1918	24.628	88.750	7.413	96.772	7.890
1919	18.691	63.328	5.759	111.122	6.988
1920	17.456	48.273	7.957	100.900	7.671
1921	12.502	29.916	4.545	62.654	4.655
1922	13.382	32.554	5.734	67.528	5.716
1923	14.421	42.664	7.267	64.873	6.607
1924	13.024	50.176	8.097	66.781	6.344
1925	14.042	57.893	9.020	69.065	7.622
1926	13.795	65.285	8.417	62.107	7.337
1927	12.920	64.353	6.755	56.370	6.242
1928	14.570	50.427	6.305	58.176	6.027
1929	18.107	45.155	6.833	52.993	6.512
1930	12.982	31.694	5.517	38.154	4.556
1931	8.116	24.467	4.243	28.700	3.640
1932	5.555	22.017	3.180	27.892	2.876
1933	7.025	39.110	3.869	34.727	4.029
1934	8.428	52.191	3.860	47.973 (e)	4.158
1935	8.649	50.420	4.065	64.273 (e)	4.328
1936	9.474	46.441	4.710	45.087 (e)	4.901
1937	13.167	54.337	6.009	44.883 (e)	6.519
1938	10.000	42.301	4.739	43.225 (e)	4.610
1939	10.965	50.323	5.053	39.082 (e)	5.110
1940	11.296	49.827	5.179	34.773 (e)	6.335

(a) Lake copper 1898; domestic copper only since 1932. (b) 99 per cent tin, 1898 to 1920, inclusive; Straits tin thereafter. (c) Average for eleven months. (d) New York zinc 1898 to 1902, inclusive. (e) Other than newly mined domestic.

Prices are in cents per pound, except those for silver, which are in cents per troy ounce

SILVER

(*Continued from page* 44)

rency, establish bimetallism . . . and debase the gold and silver coinage." It added specifically: "We shall repeal . . . the (foreign) Silver Purchase Act of 1934. . . ." The Democratic platform did not mention silver.

Mexico, now the largest foreign beneficiary of American silver buying, hailed the New Deal victory at the polls in November. Mexican officials were reported as jubilant, since any immediate likelihood of a cessation of silver purchases was thus removed. On the occasion of the inauguration of General Camacho as President, the Mexican government invited as guests various American officials and members of Congress in a position of influence with reference to the silver program.

Early in 1940 the Inter-American Financial and Economic Advisory Committee in Washington recommended the establishment of an Inter-American Bank. According to the draft bylaws, the bank would be empowered to utilize silver in its operations. The Inter-American Bank proposal is still technically under consideration by Congress, which must issue a charter before the international institution can be set up. However, the expansion of the Export-Import Bank to $700,000,000 would seem to have removed any urgency from the Inter-American Bank proposal.

In a report to the War Department, "Wartime Control of Prices," Brookings Institution recommended that, in the event of war, "the subsidies now paid to the producers of silver should be discontinued immediately." The American Mining Congress, on the other hand, in its "declaration of policy" adopted in September, endorsed the continued purchase and coinage of domestic silver.

During 1940 the American Silver Producers Research Project wound up three years' work at the Bureau of Standards in Washington and elsewhere.

The Anglo-Japanese tangle over the Tientsin silver question was settled during the year, permitting the release of silver which had been held in British and French banks in the blockaded British concession.

In Japan a movement to buy up silver held by the Japanese public was started in March, when buying offices were set up in schools and department stores. United States imports of silver from Japan totaled 29,450,000 oz., being considerably larger than in any year since the purchase program began. United States silver imports directly from China and Hongkong were virtually nil in 1940.

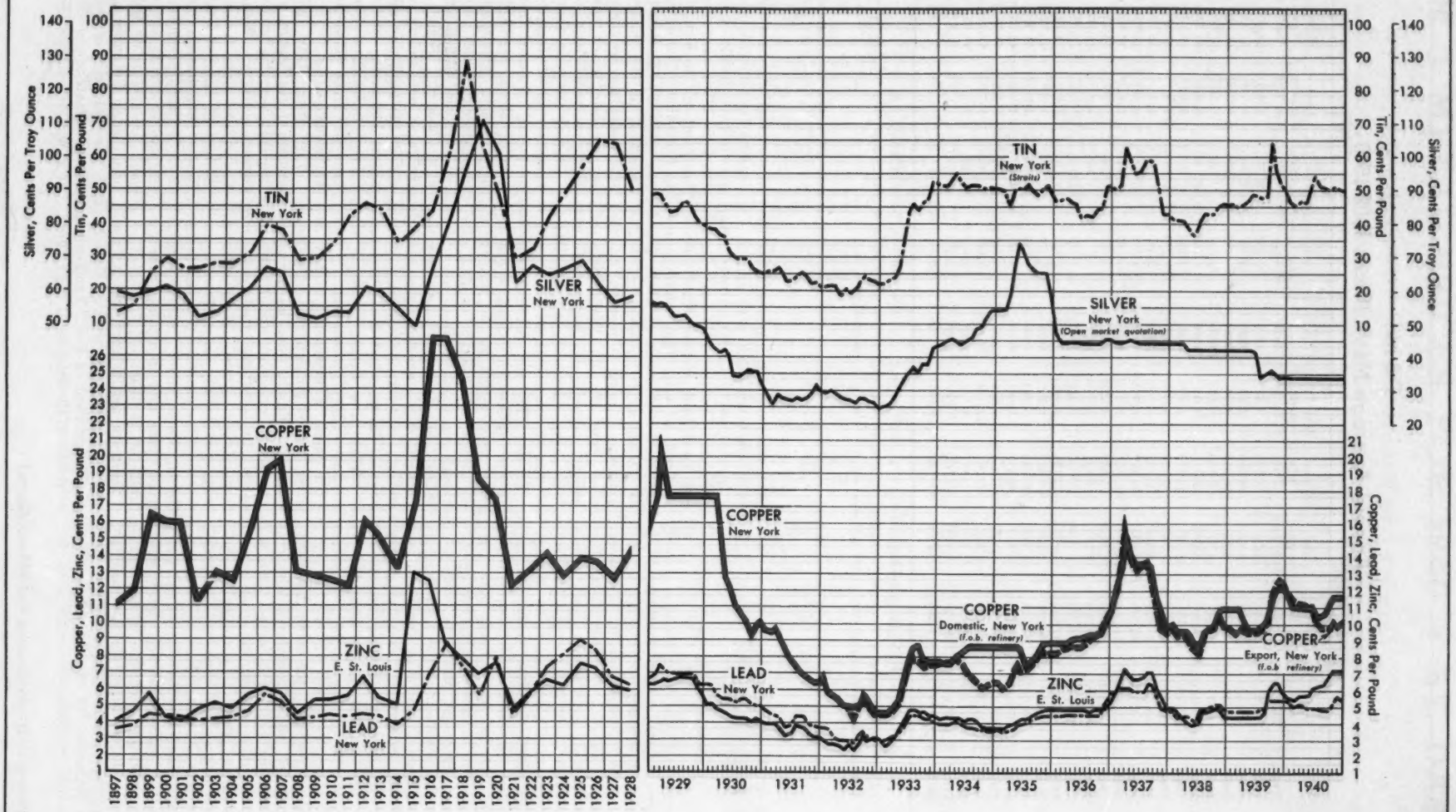
India on net balance was a small buyer of American silver. The Indian government on Feb. 10 announced reduction of the fineness of the ½-rupee silver coin, with the intention of extending the policy to other silver coins, provided no public opposition ensued. On July 26 it announced similar debasement of the ½-rupee from 0.916⅔ to 0.500 fine. The object of this step was officially described as the conservation of the government's silver stocks, depleted by the panicky hoarding of coin which accompanied the European hostilities of May and June.

During the year, the United States' monetary silver stock, valued at $1.29 an ounce, increased from $3,790,000,000 to about $4,049,000,000. Silver bullion held specifically as reserve against certificates outstanding increased from $1,298,000,000 to about $1,398,000,000. Standard silver dollar coins outstanding were $48,000,000 at the beginning of the year and $51,000,000 at the end, while the face value of subsidiary silver outstanding increased from $394,000,000 to about $418,000,000.

The year 1940 marked certain changes in the Senate, which for silver long has been the stage of the main forensic activity. Important figures disappeared from the scene. Senator William H. King of Utah and Senator Henry F. Ashurst of Arizona failed in the primary elections. Senator Key Pittman of Nevada, silver's most prominent protagonist of the past generation, died in November. Senator John G. Townsend, Jr., of Delaware, author of two Senate-approved repeal measures, was defeated in the elections.

E & M J METAL PRICES 1897-1940

(Annual averages 1897 to 1928—monthly averages 1929 to 1940)



The Year at the Mines

650-ton mill of Standard Cyaniding Co., Lovelock, Nev.

Idaho Almaden's quicksilver reduction plant, Weiser, Idaho

Dredge of Livengood Placers, Inc., Alaska

Domado zinc-lead mill, Rialto Mining Corporation, near Cardin, Okla.

Dayton Dredging Co.'s gravel washer, Dayton, Nev.

Sherman Lead Co.'s 300-ton mill, Burke, Idaho

Lava Cap's plants for tailings and concentrates, Nevada City, Calif.

Bunker Hill smelter addition, Kellogg, Idaho, for treating tetrahedrite silver ores

United States

Advances in technology, with use of modern equipment, contribute to new production records. Mining industry will attempt greater output, with government watching metal prices

H. C. Chellson
Associate Editor

OCCUPYING the vital position as supplier of raw materials for a gigantic undertaking in national defense, the metal-mining industry demonstrated its ability, in the early phases of this effort during 1940, by producing nearly a million tons of copper, half a million tons of lead, and close to seven hundred thousand tons of zinc, in addition to the largest gold output in the history of the nation and a new record for silver production. Many factors contributed to this achievement. Outstanding, perhaps, is a broader utilization in mine and mills of advanced technique and greater use of new equipment to lower operating costs. The desire of mining companies and the government to discuss and understand mutual problems involving production and prices clarified the industries' position and the apparent growing willingness of mine operators and labor to conciliate differences, and appeal for tolerance and understanding of each others' problems, were in no small measure an encouraging contribution to the general welfare of the industry.

Performance by the industry in 1941, obviously, will be influenced by unpredictable events in a world bereft of reason, but the die is cast for higher metal production. This objective, will, however, be limited by circumstances found in ore deposits that cannot be judiciously exploited under the present limits of metal prices, now virtually frozen by the government.

A brief summary of activities in the States responsible for the major 1940 production, together with statistics from the United States Bureau of Mines, follows:

ARIZONA—Modest increases in production of copper and lead were made in 1940, but zinc output rose 129 percent compared with that of 1939, the largest in the history of the State. Gold and silver production, however, declined. Gold from lode mines totaled about 285,000 oz., against 310,044 oz. in 1939, and gold placer output is estimated at 6,700 oz., against 6,404 in the previous year. Principal reasons accounting for this decline are: less copper output from the United Verde mine, the closing of the Montana mine of the Eagle-Picher company, and less production of siliceous gold ore from mines at Oatman. About 67 percent of gold from placers was recovered by dragline plants on Big Bug and Lenox Creeks in Yavapai County and by drift mining at the Arizona Drift property, in Yuma County. Two new dredging operations were started in 1940. At the Hill property, near Mayer, on Big Bug Creek, a 2½-cu.yd. dragline and floating washing plant started work in September, and a ⅝-cu.yd. dragline and portable washing plant began operation in June at the Peach and Brown property, on Lynx Creek. Five properties accounted for about 55 percent of total gold output. They were the Copper Queen and New Cornelia, both large copper producers of the Phelps Dodge Corporation; the Gold Road; Mammoth-St. Anthony; and United Verde mines.

The 11 percent drop in silver production resulted largely from a decline in output from the Montana, Copper Queen, United Verde, Ash Peak, and Arizona Magma properties. About 55 percent of the silver output came from the Copper Queen and United Verde copper mines and the property of the Magma Copper Co. Other producers were the New Cornelia, Denn, Reymert, Trench, Iron King, and Montana mines. Continuing as the nation's largest copper producing state, Arizona's 1940 output was 558,000,000 lb. of copper, a 6 percent rise over the record for 1939. The Bureau of Mines reports that during the war period (1914-18) Arizona produced a yearly average of 610,369,126 lb. of copper and from 1923 to 1929, inclusive, a yearly average of 711,203,937 lb., the record year being 1929, with 830,628,411 lb. produced, when the average price for copper that year was 18.107c. refinery. The average price in 1940 was 11.296c. Largest producer in 1940 was again the New Cornelia mine of the Phelps Dodge Corporation at Ajo. The chief copper district was the Globe, where the Inspiration and Miami mines produced a total of 139,800,000 lb. of copper, against 124,800,154 lb. in 1939.

Steady production at the Trench and Tennessee-Schuykill mines, near Patagonia and Chloride, respectively, and greater output at the Flux, Denn, and Duquesne properties, accounted for the principal gain in lead production. About 75 percent of the lead output was recovered from zinc-lead ore and the remainder from gold and lead ore. The Trench mine of the American Smelting & Refining Co. was the largest lead producer in 1940. The Mountain mine, at Ruby, largest lead producer in Arizona from 1934 to 1939, ceased operations in May owing to commercial ore exhaustion.

Virtually all the zinc produced in 1940 came from the following properties: Tennessee-Schuykill, Chloride; Magma, at Superior; Trench, near Patagonia; Denn, near Bisbee; Iron King, at Humbolt; Duquesne and Flux, near Patagonia; Montana, at Ruby; and Hillside, near Hillside.

CALIFORNIA—For the first year since 1930, gold output in California declined. Production in 1940 was about 1,408,700 oz., against 1,435,264 oz. in 1939. This decline of 2 percent is accounted for by the fact that some properties were idle in 1940, or operating on a reduced basis, and that a labor strike occurred at the Selby smelter from July 1 to Nov. 9. This forced several weakly financed properties to shut down. The leading gold producers were Idaho Maryland Mines Corporation, and the Empire Star Mines Co., Ltd. The rich ore find in 1939 by the Alhambra-Shumway Mines, Inc., encouraged development work in the Eldorado County section of the Mother Lode during the year. Leading gold producers from placer operations were Yuba Consolidated Gold Fields, Natomas Company, Snelling Gold Dredging Co., and Consumnes Gold Dredging Co. Dragline operations apparently increased, as the Bureau of Mines preliminary estimate indicates

that the 1940 figures exceed the 109 dragline dredges in operations during 1939.

As most of the silver from California mines is derived from the gold mines, this accounts for a decline in this metal during 1940. The principal silver-producing area, however, was in the Mojave district of Kern County, where the Cactus Mines Co., the Golden Queen Mining Co., and the Lodestar Mining Co. accounted for a substantial silver output, derived as a byproduct from gold ores.

Copper output in 1940 came from the Walker mine, operated at capacity by the Walker Mining Co. California copper output was 60 percent higher in quantity and 74 percent higher in value than in 1939, due principally to the activity at this property. The lead and zinc output was small, as in recent years, but volume was above that of 1939.

Fairplay, expects to start operation of its new 10,000-cu.yd. per day gold dredge.

Silver production totaled about 9,559,762 oz. in 1940, against 8,496,488 oz. in 1939. The principal producing county was Eagle, where the New Jersey Zinc Co., Empire Zinc Division, operated its Eagle mine, at Gilman, near Red Cliff. The gross value of Eagle County's metal output was the largest of any in the State.

Lead production in 1940 totaled 22,378,000 lb., against 16,444,000 lb. in 1939. San Juan County, wherein is located the Shenandoah-Dives Mining Co., accounted for a substantial volume of the lead output. The company enjoyed steady operation of its 750-ton selective-flotation plant, treating its own as well as custom ore. In Lake County the American Smelting & Refining Co. operated its lead bullion-lead copper matte smelter at Baunhoff dredges at Centerville; Yellow Pine mine, at Stibnite; and the Triumph mine, near Hailey. About 60 percent of the State's silver output during the year was recovered from silver ore and the remainder largely from zinc-lead ore. Production from the nation's largest silver producer, the Sunshine Mining Co., declined from 9,414,514 oz. in 1939 to about 8,100,000 oz. in 1940. Other large silver producers were Bunker Hill & Sullivan, Polaris, Hecla, Morning, Triumph, Coeur d'Alene, Page, Star, and Crescent.

The 33 percent gain in copper output, making the 1940 total 6,700,000 lb., against 5,032,000 lb. in 1939, was principally due to the large increase of silver-copper ore from the Mineral Point mine, near Kellogg, and to production of copper ore from Empire mine, near Mackay, operated by the Mackay Exploration Co. More than

Principal United States Production of Gold, Silver, Copper, Lead and Zinc

(United States Bureau of Mines)

Mine production of metals in 1939 and 1940 in terms of the recovered and recoverable metal in ounces and short tons. Figures for 1940 estimated.

	Gold, Oz.		Silver, Oz.		Copper, Tons		Lead, Tons		Zinc, Tons	
	1939	1940	1939	1940	1939	1940	1939	1940	1939	1940
Arizona	316,453	292,500	7,824,004	6,948,000	262,112	279,000	10,771	12,750	6,711	15,400
California	1,435,264	1,408,700	2,599,139	2,235,000	4,180	6,683	526	1,144	6	73
Colorado	366,852	368,798	8,496,488	9,559,762	13,215	12,296	8,222	11,189	1,830	4,847
Idaho	116,662	145,000	17,222,370	17,235,000	2,516	3,350	90,981	103,800	47,549	70,650
Montana	264,173	275,700	9,087,571	12,357,000	97,827	176,600	16,555	21,950	34,799	51,750
Nevada	361,518	367,400	4,316,029	5,105,000	66,597	75,910	4,236	7,460	6,228	11,430
New Mexico	36,979	39,374	1,400,878	1,372,133	46,142	71,864	5,362	4,044	29,356	29,694
Oregon	93,372	112,700	105,388	178,000	48	90	15	26	.....	.....
South Dakota	618,536	592,936	167,584	172,966	.....	6	.....	7	.....	.....
Texas	324	340	1,341,945	1,365,698	34	29	277	223	.....	.....
Utah	277,751	352,770	10,758,657	12,266,138	171,890	229,923	67,634	77,047	34,526	43,873
Washington	90,420	84,665	442,063	365,670	8,998	9,429	3,718	2,829	10,131	11,971
Wyoming	583	768	75	121	.....	3	.....	.....	.....	.....
Central States	4	5	315,953	361,302	43,985	46,100	198,481	206,267	231,716	248,500
Eastern States	17,414	18,300	94,083	130,432	10,648	12,036	6,284	4,849	180,955	178,181
Alaska	676,737	765,200	201,054	198,300	128	35	937	900	.....	.....
Totals	4,673,042	4,825,156	64,373,281	69,850,522	728,320	923,354	413,999	454,545	583,807	666,369

COLORADO—The year 1940 witnessed an increase in production of gold, silver, lead, and zinc but a 7 percent decline in copper output. Increases of molybdenum, tungsten, vanadium, and manganese were also reported, with the value of these metals estimated at $19,000,000, which added to $24,233,889 for gold, silver, and base metals, makes the production of the State in 1940 valued at $43,000,000. The Cripple Creek district was the largest gold-producing area in the State, accounting for 36 percent of the State total. There was a slight decline in this district, however, 131,049 oz., against 134,003 oz. in 1939, which is accounted for by a decline in the average grade of the ore treated. Gold production from the district is not expected to increase until the 6-mile Carlton drainage tunnel is completed some time early in the second quarter of 1941. Another important gold-producing district was Clear Creek County, where Minnesota Mines, Inc., was the largest supplier. In 1941 the Platte River Dredging Co., operating below Leadville, handling 120,711 tons of ore and concentrate, against 11,526 tons in 1939. The Rico Argentine Mining Co., at Rico, in Dolores County, was another important lead producer that was active throughout the whole year. This company, together with operations conducted by St. Louis Smelting & Refining Co., also near Rico, was responsible for a substantial volume of zinc produced in 1940. Total zinc output for the State in 1940 was about 9,694,000 lb., against 6,034,000 lb. in the previous year. Climax Molybdenum Co. operated during the year, producing about 22,000,000 lb. of elemental molybdenum, against 21,800,000 lb. in 1939.

IDAHO—Mining in 1940 produced increases in all common metals over the record for 1939. Gold output from lode mines accounted for 87,000 oz., against 67,999 oz. in 1939, and placer operations produced about 58,000 oz., against 48,663 in the previous year. Among the leading gold producers was the Boise Rochester-Monarch group at Atlanta; the Fisher & half of the State copper recovered, however, came from the Sunshine silver mine and the Mineral Point mine, the remainder being recovered as a product from the zinc-lead mines.

The gain in lead production was 14 percent in 1940, or 207,600,000 lb., against 181,962,000 lb. in 1939. This is the largest since 1930. In 1917, when Idaho had its record lead output of 393,559,521 lb., the average price of lead for that year was 8.787c. New York. Average price in 1940 was 5.179c. New York. The largest producer was the Bunker Hill & Sullivan mine, followed by the Morning, Hecla, Page, and Star mines.

Zinc production in Idaho in 1940 was the largest in the history of the State, involving about 141,300,000 lb., against 95,098,000 lb. in 1939. Most large producers in the Coeur d'Alene region increased production, but the largest output came from the Morning mine, at Mullan, followed by the Star, Bunker Hill & Sullivan, Hecla, Triumph, Tamarack & Custer, Page, Frisco, and Interstate properties. These properties accounted for 97

percent of the State total. In 1940 about 2,500,000 tons of ore were produced in Idaho, against 2,108,445 tons in 1939, with approximately 78 percent of the total produced from mines in the Coeur d'Alene region. New plants were constructed in 1940 at the Tamarack & Custer mine, near Burke; the Sherman mine, near Wallace; Mineral Point mine, near Kellogg; Lincoln mine, at Pearl; and Fall Creek mine, near Gilmore. A new plant to recover antimony and bismuth from the silver ores and concentrates from the "dry-ore-belt" section of the Coeur d'Alene region was constructed and operated by Bunker Hill & Sullivan Mining & Concentrating Co. at Bradley.

MONTANA—Mining in Montana during 1940 involved handling about 5,230,000 tons of ore and old tailings, against 3,792,780 tons in 1939.

Gold production reached 275,700 oz., the largest output since 1887, when 289,212 oz. was produced. The 1940 gain resulted from greater output from placer operations, which accounted for 65,000 oz. in 1940, against 54,999 oz. in 1939. Production from lode mines increased from 209,174 oz. to about 210,700 oz. in 1940. Seven bucket dredges accounted for 39,000 oz. of gold and several dragline dredges produced 22,000 oz. The largest producer of placer gold was the bucketline dredge on Prickly Pear Creek near Clancy, operated by the Winston Brothers, followed by the Porter Brothers' bucket-line dredge, at Helena, and the Pioneer dredge, at Gold Creek. The leading gold producer among dragline dredge operations was Ralph Davis, Inc., at Marysville. The property accounting for the largest gold output in Montana during the year was the West Mayflower mine of the Anaconda Copper Mining Co.

Most of the gain in silver production resulted from greater copper output and zinc-lead ore from the Butte mines of the Anaconda company, where about 72 percent of the State's silver was produced in 1940. The Bureau of Mines reports that about 51 percent of Montana's silver output was recovered from copper ore concentrated and nearly 25 per cent from zinc-lead ore concentrated, the remainder being recovered largely from crude smelting silver ore and old tailings. Silver output was 12,357,000 oz. in 1940, against 9,087,571 oz. in 1939.

Copper output showed a substantial increase in 1940, being 253,200,000 lb., against 195,654,000 lb. in 1939. About 98 percent of Montana's copper in 1940 was recovered from copper ore and mine-water precipitates from properties of the Anaconda company at Butte. The remainder was recovered from zinc-lead ore from Butte and old tailings shipped from the Hecla mine dump near Melrose.

Lead production in 1940 was the highest in Montana's history, totaling 43,900,000 lb., against 33,110,000 lb. in 1939. Increased activity at the zinc-lead mines of the Anaconda Copper Mining Co. and properties of other companies in the State to meet the demand for metal accounted for this large output. About 34 percent of the State lead production is reported recovered from zinc-lead mines operated by the Anaconda company. This company also produced the largest volume of zinc in the State. Montana's total 1940 zinc output was 103,500,000 lb., against 33,902,000 lb. in 1939. The Great Fall's electrolytic zinc plant and the one at Anaconda, operated by the Anaconda company, were virtually at capacity during 1940.

NEVADA—Gold production in 1940 increased only slightly, whereas, large output was reported by copper, lead, and zinc mines. The value of 1940 metal output was estimated to be the greatest since 1918, totaling $35,876,782, against $30,480,870 in 1939. The Getchell Mine, Inc., operating in the Potosi district, Humbolt County, continued to be the largest producer of gold in the State, followed by the Nevada Consolidated Copper Corporation and Consolidated Coppermines Corporation. Among placer operations, the Manhattan Gold Dredging Co. was the largest producer. Estimated gold output in 1940 totaled 367,400 oz., against 361,518 oz.

Expansion in lead-zinc mines and greater output from the large copper properties was chiefly responsible for the 18 percent gain in silver production, which totaled about 5,105,000 oz. in 1940, against 4,316,029 oz. in 1939. The largest silver producer, however, was the Desert Silver, Inc., which operates the Nivloc mine, in the Silver Peak district of Esmeralda County.

Copper production was the greatest in the State since 1928. Output in 1940 totaled about 151,820,000 lb., against 133,194,000 lb. in 1939. The largest producer, Nevada Consolidated Copper Corporation, was closely followed by Consolidated Coppermines Corporation, both companies operating in the Robinson district of White Pine County. The remainder was chiefly accounted for by the Mountain City Copper Co., operating its Rio Tinto mine, in the Cope district, Elko County.

About 60 percent of the lead and 90 percent of the zinc came from the Pioche district, Lincoln County, where the leading operations are directed by Combined Metals Reduction Co. This company started construction of a 450-ton flotation plant in June, to treat locally the complex zinc-lead ore found in the bedded deposits. Other zinc producing areas in the State were the Yellow Pine district of Clarke County and the Merriman district of Elko County. Estimated 1940 lead output in the State is 14,920,000 lb., against 8,472,000 lb. in 1939. Zinc production for 1940 is estimated at 22,860,000 lb., against 12,756,000 lb. in the previous year.

UTAH—From 27,298,000 tons of ore mined in the State in 1940, against 21,094,997 tons in the previous year, came a new record of gold and copper output for the State. Approximate total value of this volume of ore is $86,440,325, an increase of 38 percent over 1939. The principal gain in gold is accounted for by large increase in production at the copper mine of Utah Copper Co., where both gold and silver are recovered as by-products in the copper ore. Second in production of gold was the Consolidated Mercur property at Mercur. The Park City region increased its gold output, due to greatly increased operations at the New Park Mining Co. Gold output for 1940 totaled 352,770 oz., against 277,751 oz. in the previous year.

The leading silver producers in the State were the United States and Lark and Utah Copper, both in the Bingham district; the Tintic Standard, in the Tintic district, and the Silver King, in the Park City region. Silver production increased 14 percent in 1940 over the figures for 1939, totaling 12,266,138 oz., against 10,758,657 oz. in 1939.

The 1940 copper output set a new high for the history of the State, totaling 459,846,000 lb., against 343,780,000 lb. in the previous year. The previous high was in 1937, when 411,988,000 lb. was produced. The open-pit mine of the Utah Copper Co. in the Bingham district and its mills at Magna and Arthur were operated at a higher rate than in 1939 and the company continued to be the nation's leading copper producer. Other operations contributing to the State's output were the United States and Lark and the Ohio Copper properties, in Bingham; the Ophir Hill, in Tooele County, and the Tintic Standard mine, in the Tintic district.

The substantial gain in lead and zinc output in 1940, 14 percent and 27 percent respectively, was due chiefly from increased operations by the Park Utah Consolidated Mines Co. and greater output from the Silver King mine. Total lead production in 1940 was about 154,094,000 lb., against 135,268,000 lb. in 1939, and zinc output 87,746,000 lb., compared with 69,052,000 lb. in the previous year.

Canada

Record-breaking operations result in mineral production valued at more than half a billion dollars. Few promising new discoveries due to little prospecting

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ALL BRANCHES of the Canadian mineral industries in 1940 were operating at a rate never before attained, the total estimated value being "in excess of half a billion dollars." This announcement was made by the Hon. Thomas A. Crerar, Minister of Mines and Resources, replacing the detailed statements formerly issued by the Dominion Bureau of Statistics in keeping with war restrictions that prevent the publication of base-metal production figures. It is known, however, that International Nickel, Noranda, Hudson Bay Mining & Smelting, Sherritt Gordon, Britannia, Granby, Consolidated Mining & Smelting of Canada, Waite Amulet, Aldermac, and Normetal are operating at larger capacities than a year ago, and that several copper-zinc-lead mines that were inactive at the outbreak of war are now in full operation.

The record output last year compares with a value of $474,602,000 in 1939 and $441,824,000 in 1938. Gold production accounted for approximately $210,000,000 in 1940, compared with $184,000,000 the year before, when copper output was valued at $60,000,000 and nickel sales amounted to more than $50,000,000. Robert C. Stanley, chairman of the board and president of International Nickel Company of Canada, has announced that more nickel was sold in 1940 than in any previous year. Peacetime requirements have been supplied while meeting increased war demands both as to quality and quantity. International Nickel has renewed an agreement with the British Ministry of Supply for another year to deliver 80 per cent of the nickel output to the British Government, at a price lower than the prevailing market.

War hazards fell heavily on both International Nickel and Falconbridge Nickel Mines. International's subsidiary at Petsamo, Finland, was captured by Soviet troops and damaged to an undetermined extent. The mine, smelter, and power plant had been expected to go into operation in 1941. Falconbridge's refinery was located at Christiansand, Norway, and fell into the hands of the Nazis, as did an unannounced number of ore boats by torpedoing on the high seas. Falconbridge continues mining operations in the Sudbury district and the matte produced is being treated by International Nickel.

Gold mining in 1940 added only a dozen new mills with a combined capacity of 3,000 tons daily, compared with 20 new producers in 1939 with a capacity of almost 5,000 tons. The new operators included six in Ontario and two each in Quebec, British Columbia, and Nova Scotia. The outstanding addition to the list, now totaling 136 active mills, was Aunor, in the east Porcupine camp, with a 400-ton plant. Powell Rouyn, in Quebec, built a 350-ton mill and continues to ship about 400 tons of fluxing ore to the Noranda smelter. The Nova Scotia and British Columbia mines installed plants of 25 tons' capacity or less. The outlook for 1941 is for about the same rate of expansion as in the past year, which is less than for the last five-year period. New mills now under various stages of construction aggregate about 2,800 tons, but this figure includes established producers enlarging plant facilities.

New mills planned for construction in 1941 total 18, with a combined capacity of 3,050 tons. Of these, eight are in Ontario, six in British Columbia, two in Manitoba, and one each in Saskatchewan and Nova Scotia. In Quebec, there is the possibility that both National Malartic and West Malartic will be ready for mills in 1941, and the mill now building at Senator Rouyn is to be completed this spring. By the end of 1941 the daily mill capacity of Canada's gold mines is estimated to reach approximately 60,000 tons.

The listless prospecting activity that has prevailed since 1936 persisted through 1940, with the result that only one or two promising discoveries were reported in Ontario and none at all in Quebec. Both gold and base-metal mining have been classified as essential war industries and the Federal Government has recently announced a policy to stimulate exploration and development to secure greater production. In the case of Noranda and other producers, 1940 taxes were 50 per cent higher than in 1939, but fair treatment is promised through special powers granted to the Minister of Finance that will make possible the consideration of each mine on its merits. Under certain conditions the government may assist properties in reaching the stage of production. The prospect of gold stabilized at $38.50

Table I—Cumulative Dividend Record of Canadian Metal Mines (a)

Province and District	1937	1938	1939	1940 (b)	Total to Oct. 31, 1940
ONTARIO:					
Sudbury (c)	$37,776,054	$32,103,201	$32,091,513	$24,051,466	$317,939,467
Cobalt (c)	444,000	180,000	180,000	.....	106,982,442
Porcupine (c)	12,169,765	12,830,335	14,254,781	13,973,469	186,179,599
Kirkland Lake (c)	20,259,948	16,299,277	15,940,989	11,812,676	165,088,969
Patricia	2,714,950	3,095,650	3,628,503	3,465,685	15,488,188
Matachewan	.....	.....	31,682	31,682	63,364
BRITISH COLUMBIA (c)	$17,550,778	$13,852,018	$13,227,279	$8,919,700	$214,466,300
QUEBEC	8,951,527	11,234,819	13,901,065	15,617,831	81,405,098
MANITOBA	5,230,586	4,773,735	5,852,397	4,064,766	26,344,757
NOVA SCOTIA (d)	.....	.....	.....	29,496	77,424
MISCELLANEOUS	1,579,552	1,413,111	1,348,708	1,330,897	7,684,783
Totals	$104,637,160	$95,590,457	$100,276,918	$83,297,668	$1,122,700,392

(a) Based on data from *Northern Miner*. (b) Up to Oct. 31, 1940. (c) Since 1933, paid by Nipissing Mines, a holding company. (d) Dividend record incomplete. (e) Payments in U. S. funds made by Dome, McIntyre, Sylvanite, Wright-Hargreaves, International Nickel, and Granby Consolidated.

Table II—Canadian Metal Mines Producing in 1940

Mining Company	Gold Recovery per Ton 1939	Working Costs per Ton 1939 (*aa*)	Daily Tonnage 1940	Mill Capacity 1940	Date of First Production
ONTARIO					
Aunor Mines (*h*)	.....	.....	.....	420	Jan. 1940
Amherst Gold Mines (Algold) (*g*)	3.76	.....	50	100	June 1936
Algoma Ore Properties (siderite)	.....	.....	.....	2,000	July 1939
Bankfield Cons. Gold Mines	12.52	7.39	136	145	May 1937
Berens River Mines (*aaa, i*)	16.38	.....	194	255	Sept. 1939
Bidgood Cons. Gold Mines	9.09	8.64	152	160	July 1934
Broulan Porcupine Mines (*ll*)	12.74	8.38	295	300	Nov. 1939
Buffalo Ankerite Gold Mines	7.29	5.09	1,052	1,200	June 1926
Central Patricia Gold Mines	16.33	10.78	296	400	June 1934
Chesterville Larder Lake Gold	5.03	3.29	524	650	July 1939
Cline Lake Gold Mines (O'Brien)	9.44	6.31	246	250	July 1938
Cochenor-Willans Gold Mines	13.61	5.97	140	150	Dec. 1939
Coniaurum Mines (*j*)	9.36	5.93	535	600	May 1928
Cordova Gold Mines (*r, g*)	.....	.....	.....	125	Oct. 1939
Delnite Mines (Sylvanite) (##)	7.12	4.22	328	400	June 1937
DeSantis Porcupine Mines (*nn*)	7.94	5.60	155	175	May 1939
Devon Gold Mines	.....	.....	.....	50	1940
Dome Mines	12.13	4.26	1,755	1,800	1910
Elora Gold Mines (*g*)	6.03	.....	25	60	1936
Gillies Lake Porcupine Mines	7.82	.....	51	100	May 1935
Faymar Porcupine Mines	.....	.....	.....	250	Mar. 1940
Gold Eagle Gold Mines	9.09	7.39	98	150	Oct. 1937
Golden Gate Mining Co	10.81	8.68	68	150	May 1938
Hallnor Gold Mines (*k*)	21.16	5.11	351	400	June 1938
Hard Rock Gold Mines	8.16	.....	306	325	Jan. 1937
Hasaga Gold Mines (R. L. Gold Shore)	7.87	7.16	166	350	Sept. 1936
Hollinger Cons. Gold Mines	9.10	5.10	4,710	5,700	1910
Howey Gold Mines	2.51	1.25	1,341	1,500	Apr. 1930
J M Cons. Mines (*g*)	7.78	.....	.....	100	Aug. 1936
Jason Gold Mines (Argosy) (*b*)	.....	.....	.....	125	June 1940
Kenricia Gold Mines	3.75	.....	45	100	1939
Kerr Addison Gold Mines	7.39	4.00	767	1,200	May 1938
Kirkland Lake Gold Mines	17.42	7.60	284	400	1919
Lake Shore Mines	15.53	5.99	2,430	2,500	1918
Lebel Oro Gold Mines (*b*)	6.93	.....	58	110	Apr. 1937
Leitch Gold Mines	25.14	12.35	86	115	Jan. 1937
Little Long Lac Gold Mines	15.91	7.87	305	325	Dec. 1934
Macassa Mines (*c*)	15.55	9.82	423	450	Oct. 1933
Mace Gold Mines (Vipond) (*f*)	4.99	4.23	107	300	1911
MacLeod-Cockshutt Gold Mines (*aj*)	7.23	4.53	702	750	Apr. 1938
Madsen Red Lake Gold Mines	6.97	3.61	387	400	Aug. 1938
Magino Gold Mines (Algoma Summit)	.....	.....	.....	250	Nov. 1939
Magnet Cons. Gold Mines (i)	26.14	.....	50	160	July 1939
Matachewan Cons. Mines (*j*)	5.59	3.87	443	450	Nov. 1934
McKenzie Red Lake Gold Mines (*c*)	15.78	5.95	201	225	Mar. 1935
McIntyre Porcupine Mines (##)	9.95	5.22	2,525	2,550	1912
McMarmac Red Lake Gold Mines	.....	.....	.....	75	Oct. 1940
Minto Gold Mines (*g*)	4.68	5.87	52	115	June 1931
Moneta Porcupine Mines (##)	17.29	6.73	174	200	Jan. 1938
Morris Kirkland Gold Mines (*b*)	5.63	8.12	99	130	Feb. 1940
Naybob Gold Mines (Hayden)	6.02	3.50	127	200	1935
New Golden Rose Gold Mines (*mm, nn*)	12.06	8.84	109	125	July 1937
Northern Empire Mines (i)	13.67	8.63	194	200	Mar. 1934
Omega Gold Mines (##)	5.10	4.23	500	525	1936
Pamour Porcupine Mines (*h*)	4.37	3.22	1,672	1,700	May 1936
Paymaster Cons. Mines (*oo*)	8.18	.....	558	575	Oct. 1934
Pickle Crow Gold Mines (*c*)	22.86	11.45	363	400	Apr. 1935
Porcupine Lake Gold Mines (*g*)	4.28	.....	25	46	1937
Preston East Dome Gold Mines	17.80	3.58	434	510	Mar. 1939
Raven River Gold Mines (*g*)	3.78	.....	65	75	Nov. 1937
Ross Mine (Hollinger)	9.35	6.02	160	200	Jan. 1936
Sachigo River Exploration Co	50.13	.....	31	50	May 1938
Sand River Gold Mining Co	11.98	9.76	104	110	Dec. 1937
St. Anthony Gold Mines	12.33	8.43	81	150	Aug. 1927
Straw Lake Beach Mines	12.51	10.03	55	70	Nov. 1938
Sturgeon River Gold Mines	16.79	11.37	72	85	Apr. 1937
Sylvanite Gold Mines (##)	12.55	5.81	583	600	July 1927
Tashota Goldfields (*g*)	.....	.....	.....	90	Apr. 1935
Teck-Hughes Gold Mines (*zz*)	10.68	5.64	1,083	1,300	1917
Tionaga Gold Mines	.....	.....	.....	50	Dec. 1938
Toburn Gold Mines (*i, c*)	23.09	15.48	158	175	Apr. 1813
Tombill Gold Mines (i)	15.86	.....	110	115	Feb. 1938
Tyranite Mines (##)	5.29	4.02	198	200	June 1939
Uchi Gold Mines	7.13	4.62	295	750	May 1939
Upper Canada Gold Mines (*k*)	15.40	.....	134	200	Nov. 1938
Wendigo Gold Mines (*k*)	13.44	8.04	98	100	Jan. 1936
Wright-Hargreaves Mines (*c, zz*)	19.66	10.23	1,213	1,220	May 1912
Young-Davidson Mines (*s*)	3.82	2.62	1,075	1,100	Sept. 1934
International Nickel Co. (*pp*)	.....	.....	20,782	30,000	1916
Falconbridge Nickel Mines (*j*)	13.71	10.22	1,651	1,700	Feb. 1930
NOVA SCOTIA					
Avon Gold Mines (Oldham) (*b, k*)	5.82	.....	49	125	May 1936
Caribou Gold Mines (*r*)	.....	.....	.....	35	1934
Deales Mining Syndicate	.....	.....	.....	20	1938
Guysborough Mines (*j*)	7.45	6.40	95	100	1934
Higgins & Lawlor (*b*)	.....	.....	.....	20	1938
Lacey (provincial project gov't)	.....	.....	.....	35	1934
Montague Gold Mines (*g*)	6.69	4.33	.....	200	1933
N. S. Gold Mines (Tangier) (*g*)	.....	.....	.....	100	1936
Nugold Mining Corp. (B. Dome) (*g*)	.....	.....	.....	35	Jan. 1937
Otter Lake Gold Mines (*g*)	.....	.....	.....	75	July 1937
Queens Mines (*g*)	.....	.....	.....	50	1935
Seal Harbour Gold Mines	1.97	2.50	258	260	Aug. 1936
N. S. United (Brookfield) Goldfields (*g*)	.....	.....	.....	25	Feb. 1934
Waverly Cons.(L. Thomas) Gold Mines(*g*)	.....	.....	.....	75	1937
Wine Harbour Gold Mines (*b*)	.....	.....	.....	100	May 1937
MANITOBA					
Beresford Lake Mines	.....	.....	.....	75	Feb. 1940
God's Lake Gold Mines	12.96	6.56	196	200	Sept. 1935
Gunnar Gold Mines (*c*)	13.50	9.42	140	150	Apr. 1936
Gurney Gold Mines (W.-Domin.)	11.11	.....	139	140	Oct. 1937
Laguna Gold Mines (Rex) (*e*)	17.89	10.56	92	100	Aug. 1936
San Antonio Gold Mines (*c*)	10.57	6.54	321	550	July 1932
Hudson Bay Mining & Sm. (*dd, mm*)	.....	5.89	5,024	5,900	Sept. 1930
Sherritt Gordon Mines (*b, f, ll*)	.....	4.40	1,737	1,750	Aug. 1937
SASKATCHEWAN					
Athona Mines (*g*)	.....	.....	.....	15	1936
Box Mine (*r*)	.....	1.81	.....	1,300	July 1939
Monarch Gold Miners Synd. (*g*)	.....	.....	.....	25	1938
NORTHWEST TERRITORIES					
Bear Expl. & Radium (*t, **)	.....	.....	.....	35	Oct. 1935
Con Mine (*r*)	28.70	.....	.....	100	Sept. 1938
Eldorado Gold Mines (pitchblende) (*i, g*)	71.65	.....	95	100	1933
Negus Mines	35.38	.....	.....	60	Feb. 1939
Yukon Cons. Gold Corp. (*al*)	0.271	0.127			
QUEBEC					
Aldermac Copper Corp. (*d, qq*)	.....	2.18	1,043	1,200	Jan. 1937
Amm Gold Mines (*am*)	4.52	3.90	116	150	Mar. 1939
Arntfield Gold Mines (*c*)	3.17	3.39	334	400	Aug. 1935
Beattie Gold Mines (*j, x*)	4.01	2.28	1,682	1,800	May 1935
Belleterre Mines (McIntyre) (##)	10.10	6.64	214	220	Aug. 1936
Canadian Malartic Gold Mines (*j*)	4.45	2.63	670	830	May 1935
Central Cadillac Mines (*ah*)	9.00	.....	.....	225	Nov. 1939
Cournor Mining Co. (*b*)	5.86	4.00	213	225	Sept. 1937
East Malartic Mines	7.12	2.87	1,010	1,500	Nov. 1938
Francoeur Gold Mines	6.32	4.13	163	180	July 1938
Lamaque Mining Co. (Teck-Hughes) (*c*)	11.04	6.45	1,251	1,300	Apr. 1935
Lapa Cadillac Gold Mines	4.03	3.71	254	300	July 1938
Noranda Mines (*af*)	.....	.....	5,977	7,000	Dec. 1927
Normetal Mining Corp. (*e, jj, vv, ak*)	.....	5.74	444	600	Sept. 1937
Malartic Gold Fields (*nn*)	8.77	3.36	419	750	Dec. 1939
McWatters Gold Mines (*mm*)	12.92	7.95	101	150	Sept. 1934
Mooshla Gold Mines (*zz*)	28.51	5.62	14		1939
O'Brien Gold Mines	16.19	7.24	175	220	Sept. 1934
Pandora Cadillac Gold Mines	.....	.....	.....	150	Sept. 1940
Payore Cons. Mines (*g*)	.....	.....	.....	75	May 1938
Perron Gold Mines (*c*)	11.08	6.23	364	400	Apr. 1934
Powell Rouyn Gold Mines (*n, ##*)	5.08	3.73	717	350	1937
Senator Rouyn Mines	.....	.....	.....	250	Oct. 1940
Sigma Mines (Dome)	7.95	3.99	730	750	Mar. 1937
Siscoe Gold Mines	8.96	4.65	623	625	Jan. 1929
Sladen-Malartic Mines	3.62	3.70	524	650	Jan. 1938
Stadacona Rouyn Mines (*an*)	5.38	4.18	375	500	Nov. 1936
Sullivan Cons. Mines	9.58	8.12	352	360	May 1936
Thompson Cadillac Mining Corp. (*g*)	5.08	.....	70	215	June 1936
Waite Amulet Mines (*h, vv, ***)	11.06	7.21	502	1,200	June 1937
Wood Cadillac Mines (*gg*)	7.99	.....	186	250	Dec. 1939

an ounce in Canadian funds has made it possible to mine ore of lower grade and has been a factor in the last half of the year leading to a gradual increase in tonnage mined in the majority of Canadian camps.

About 60 per cent of Canadian minerals mined in 1940 came from Ontario; Quebec holds second place, followed by British Columbia, Nova Scotia, Alberta, Manitoba, Northwest Territories, and Saskatchewan. The Deputy Minister of Mines for Ontario, Harold C. Rickaby, estimates a 20 per cent increase in the value of Ontario's production for 1940, compared with 1939, reaching an all-time high at $300,000,000. The record was chiefly due to the gold mines and the nickel-copper industry, but increases up to 50 per cent are shown in structural materials and some non-metallics, due to the year's rapid industrial expansion and the building of military camps. Gold produced from all sources amounted to 3,264,267 oz., valued at $125,674,280.

Iron mining, for years inactive, was resumed in 1939 with the production of 123,000 long tons of sinter from the siderite ore of the New Helen mine, near Michipicoten Harbour, Lake Superior. The mine expanded output in 1940 to an estimated 325,000 tons, and a further advance to 450,000 tons is planned for this year. The Algoma Steel Company, Sault Ste. Marie, takes part of the sintered ore and the remainder is shipped to Cleveland. Diamond drilling and underground work are proceeding on the high-grade hematite property at Steep Rock Lake, east of Port Arthur.

Cobalt shipments can be made only under permit from the Metals Controller at Ottawa, and no figures have been published on the production of this metal. The demand for mica, fluorspar, barite, and other non-metallic minerals was steady in 1940, and an increase in salt production met demands of the chemical industries. Ontario produced non-metallics valued at $15,000,000 and structural materials

Table II—Canadian Metal Mines Producing in 1940

Mining Company	Gold Recovery per Ton 1939	Working Costs per Ton 1939 (a)	Daily Tonnage 1940	Mill Capacity 1940	Date of First Production
BRITISH COLUMBIA					
Aztec Mining Co. (B. R. X. Gold)	.....	.....	.....	150	May 1938
Bayonne Cons. Mines	.....	.....	.....	50	Apr. 1940
Beelemore Milling Co. (Wayside, g)	.....	.....	.....	150	Nov. 1939
Brooklyn Stemwinder Gold Mines	.....	.....	.....	60	1939
Bralorne Mines (g)	20.37	10.17	529	550	Feb. 1932
Caribou Gold Quartz Mining Co.	15.53	8.34	301	325	Jan. 1933
Caribou-Hudson Gold Mines (g)	10.01	.....	50	100	Dec. 1938
Central Zeballos Gold Mines	.....	.....	.....	25	Jan. 1940
Columbia Tungstens	.....	.....	.....	25	1939
Cons. Nicola Goldfields (Jenny Long, b)	.....	.....	.....	100	May 1940
Dentonia Mines (Durango) (u, g)	.....	.....	.....	100	Jan. 1938
Fairview Amalg. Gold Mines (tt)	4.23	3.61	100	150	1936
Gold Belt Mining Co. (##)	9.64	4.50	147	165	Oct. 1938
Gold Mt. Mines (Hedley) (g)	5.43	.....	.....	50	Dec. 1936
Grange Cons. Mines (Pavilion Mt., g)	.....	.....	.....	50	Oct. 1934
Greenbridge Gold Mines	.....	.....	.....	100	1938
Greenwood Ore Concentrating Co.	.....	.....	.....	50	
Hedley Mascot Gold M. (a, c, t)	9.21	7.04	185	240	May 1936
Highland Bell (t, àà)	.....	.....	.....	.....	1930
Highland Surprise	.....	.....	.....	75	1940
Island Mountain Mines (ii)	15.97	8.91	128	150	Nov. 1934
Kamloops Homestake M. (g, u)	14.03	.....	.....	50	1936
Kelowna Expl. Co. (s)	.....	.....	200	225	1934
Kootenay Belle Gold M. (b, u)	12.99	.....	122	150	Dec. 1934
Mount Zeballos Gold Mines	17.85	10.19	49	50	Aug. 1939
New True Fissure Min. & Mill. (g, u)	.....	.....	.....	100	Oct. 1937
Osoyoos Mines	16.45	.....	.....	150	Oct. 1935
Pioneer Gold M. of B. C. (l, ##)	20.14	7.56	214	375	1928
Polaris-Taku Mining Co.	12.00	.....	.....	300	1938
Porcher Island Mines (g)	.....	.....	.....	50	Jan. 1939
Privateer Mines	44.44	8.97	79	85	Oct. 1938
Quesnell Quartz Mining Co.	.....	.....	.....	25	Jan. 1939
Relief-Arlington Mines (i)	16.89	11.91	89	100	1933
Reno Gold Mines (k)	14.50	10.46	120	140	Aug. 1929
Reward Mining Co. (Surf Pt.) (b)	12.34	.....	.....	25	Feb. 1937
Rey Oro Gold Mines (g)	140.00	.....	5	15	1938
Sheep Creek Gold M. (Queens) (a, c)	17.86	10.53	148	150	May 1935
Silbak Premier Mines (i, m)	10.25	5.81	483	550	1919
Skidgate Gold Mines (g)	.....	.....	.....	70	1937
Spider Gold & Silver M. (g)	.....	.....	.....	50	1938
Spud Valley Gold Mines (aa)	25.81	.....	65	75	Nov. 1938
Stewart Canal Gold Mines	.....	.....	.....	12	1940
Surf Inlet Cons. Gold M. (oo)	14.48	.....	78	120	Apr. 1936
Vancouver Island Gold Mines	.....	.....	.....	25	1938
Velvet Gold-Copper Mines (a, g)	.....	.....	.....	100	1932
Vidette Gold Mines (a)	.....	.....	70	80	Dec. 1935
Weske Mines (Central) (g, u)	7.89	6.02	90	100	Nov. 1936
Western Expl. Co. (g)	.....	.....	.....	150	1938
Wilcox Mining Synd. (u)	16.50	.....	12	20	1934
Windpass Gold Mining Co.	.....	.....	40	50	Jan. 1934
Winslow Cons. Gold Mines	.....	.....	.....	30	1940
Ymir Cons. Gold Mines (u)	.....	.....	30	100	July 1935
Ymir Yankee Girl Gold (u, zz)	10.13	8.22	154	160	July 1934
Base Metals Mining Corp. (b, e, p)	.....	.....	.....	300	Nov. 1937
Britannia Min. & Smelt. Co. (a, p, t, w)	.....	.....	.....	6,500	1903
Buena Vista Min. Co. (Big Missouri) (r)	2.60	2.26	568	750	Apr. 1938
Columbia Tungstens	.....	.....	.....	50	1939
Cons. Mining & Smelting Co. (Kimberley) (p)	.....	.....	.....	6,600	1906
Cons. Mining & Smelting Co. (Tadanac, (a, y)	.....	.....	.....	2,400	1936
Granby Cons. Min. & Smelt. (a, b, ee)	.....	.....	4,800	5,000	June 1937
Noble Five Mines (Slocan) (b, u)	.....	.....	.....	100	Aug. 1935
Mining Corp. of Canada (Monarch) (y)	.....	.....	.....	280	Jan. 1940
Pinchi Lake Mercury (r)	.....	.....	.....	10	1940

(a) Copper-gold producer. (b) Former producer. (c) Costs include all charges. (d) Shipping copper and sulphur concentrates. (e) Controlled by Mining Corp. of Canada. (f) Copper-gold-silver producer. (g) Production temporarily suspended. (h) Controlled by Noranda Mines. (i) Controlled by Premier Gold Mining Co., one of the ten principal foreign development companies of American Smelt. & Refin. Co. (j) Controlled by Ventures Ltd.; 45% in Beattie Gold. (k) For fiscal year ending Apr. 30, 1940. (l) Shut down by labor strike, Oct. 1939–Mar. 1940. (m) Controlling 5 mines in the Portland Canal area, including Premier, the largest silver producer in Canada. (n) Shipping flux-gold ore to Noranda. (o) Approx. monthly output, 1939: ag 80,000 oz. radium 3 grams; value of radium, uranium and silver producer in 1937, $850,000; large stocks at refinery led to mine shutdown in 1940. (p) Silver-lead-zinc producer. (q) Also treating ore from Bradian mine. (r) Controlled by Cons. Min. & Smelt. Co. of Canada. (s) Formerly largest B. C. gold producer. (t) Silver producer. (u) Gold-silver-lead-zinc producer. (v) First 4 months, 1937. (w) Controlled by Howe Sound Co. (x) Controlled by Nipissing Mines. (y) At Trail are located custom concentrator, zinc production plant and refinery, copper smelter and refinery, lead smelter and refinery, fertilizer plant, etc. (z) Controlled by Hollinger Cons. Gold Mines. (#) Combined with Marbuan, formerly March Gold Mines. (aa) Mining costs per ton, 1936. (bb) Figures for 1937, excluding 182,514 lb. copper in concentrates. (cc) Mill operated Aug.–Nov. 1937. (dd) Ore milled in 1939 av. 2.01% cu.; 4.14% zn.; 0.106 oz. au.; 1.59 oz. ag. Smelter byproducts were cadmium, selenium, tellurium. (ee) Before taxes, depreciation, depletion. (ff) Mill leased to Broulan, 1939–40. (gg) First quarter 1940. (hh) First half 1938. (ii) Controlled by Newmont Mining Co. (jj) Copper concentrates treated at Noranda, zinc concentrates in England; 1939 production: 6,000,000 lb. cu.; 18,000,000 lbs. zn; 2,400 oz. au; 300,000 oz. ag. (kk) January 1939. (ll) First quarter 1940. (mm) Including depreciation. (nn) First 4 months 1940. (oo) Production in 1939: 33,500,000 lb. cu. (pp) Production in 1939 from Frood, Creighton, Levack & Carson mines: 210,194,135 lb. ni; 324,850,921 lb. cu; 2,448,386 oz. ag; 78,751 oz. au; 240,778 oz. platinum metals; 99,686 lb. selenium; 3,288 lb. tellurium. (qq) Av. ore grade 1.97% cu; 0.011 oz. au; 0.435 oz. ag and 50% sulphur concentrates. (rr) For first 10 months operation. (ss) For fiscal year ended June 30, 1938. (tt) For April 1940. (uu) For fiscal year ended Aug. 31, 1938. (vv) Copper-zinc-gold producer. (ww) For first 9 months 1939. (xx) For fiscal year ended Aug. 31, 1940. (yy) For first 10 months 1938. (zz) For fiscal year ended Oct. 31, 1938. (àà) For fiscal year ended Mar. 31, 1940. (*) Av. monthly output in 1938, 11% uranium, 50,000 oz. ag in concentrates. (**) Av. ore grade 1939: 5.23% cu; 0.71% zn; 0.323 oz. ag; 0.0321 oz. au. (aaa) For first 6 months production. (abb) For first 8 months production. (acc) For fiscal year ended May 31, 1939. (add) Except taxes. (aee) 1938 production: 8,012.7 tons ni; 4,108.5 tons cu in matte; ore grade 1.80% ni; 0.94% cu. (aff) 1939 production: 83,257,148 lb. cu; 266,532 oz. au; 595,102 oz. ag. A Noranda subsidiary treats copper from Waite Amulet, Normetal and Hudson Bay Min. & Smelt. (agg) First 11 months 1939. (ahh) Operating Thompson Cadillac mill. (aii) For Nov. 1939. (ajj) For fiscal year ended Sept. 30, 1940. (akk) Av. ore grade, 1939: 2.57% cu; 8.307% zn; 0.03 oz. au; 2.946 oz. ag. (all) Ten dredges treated 10,090,182 cu.yd. in 1939. (amm) Mill now operated by Pandora Cadillac. (ann) Operating in bankruptcy under custodian. (aoo) For fiscal year ended June 30, 1940.

estimated at $18,000,000, compared with a total for both in 1939 of $25,168,870 and $22,020,079 in 1938. A similar expansion is suggested for the other provinces, although details have not yet been issued.

In Quebec, asbestos production in the Eastern Townships at Thetford and at the Johns-Manville plants at the town of Asbestos touched record levels. Noranda, Waite Amulet, and other copper producers increased output, most of which was sold under agreement to the British Government at 10.5c. a pound. Canadian Copper Refineries, a Noranda subsidiary operating at Montreal, made extensive increases to its capacity. Gold mines enlarging mill capacity included Belleterre, Sigma, East Malartic, Canadian Malartic, and Malartic Gold Fields.

In the Northwest Territories, where native silver and pitchblende were discovered in 1930 by LaBine, unsettled conditions in radium markets caused a shutdown last June of the Eldorado mine and concentrator at Echo Bay, Great Bear Lake. A three-year supply of concentrates is on hand at the refinery at Port Hope, Ontario. Gold production in 1940 from mines in the Yellowknife area will exceed $2,000,000, the first brick having been poured in September, 1938, at the Con mine. In February 1939 production was started at the Negus mine, treating 60 tons daily with a monthly output of about $60,000. Thompson-Lundmark Gold Mines is building a 100-ton plant and small shipments of rich ore are being made from Giant Yellowknife to Trail, B. C. A small mill is planned for Great Slave Lake Gold Mines. Promising discoveries have been reported from several districts in the past two years. An oil refinery that for several years has supplied fuel oil for the Eldorado mine is now refining high-grade aviation gasoline, with a daily capacity of 840 barrels, for shipment to Yellowknife and other sub-Arctic and Arctic areas. The reduced price of this fuel may prove a factor in stimulating mining development in the Territories.

The three prairie provinces are celebrating the first decade of provincial ownership of their natural resources, which had been administered by Federal authorities prior to 1930. In this period, Manitoba mining has grown from an output of metals valued at $870,248 to $15,511,069 in 1939, which will be surpassed in 1940, owing chiefly to expansion at Flin Flon and San Antonio. Hudson Bay Mining & Smelting Company increased daily output by 400 tons and is enlarging the flotation mill and the zinc-leaching plant to provide another 700-ton increase. The south main shaft, largest on the continent, is to cost $2,500,000 when complete and is in Saskatchewan at the west end of the orebody. The power plant for the mine, also in Saskatchewan at Island Falls, has been stepped up so that it can produce 90,000 hp.

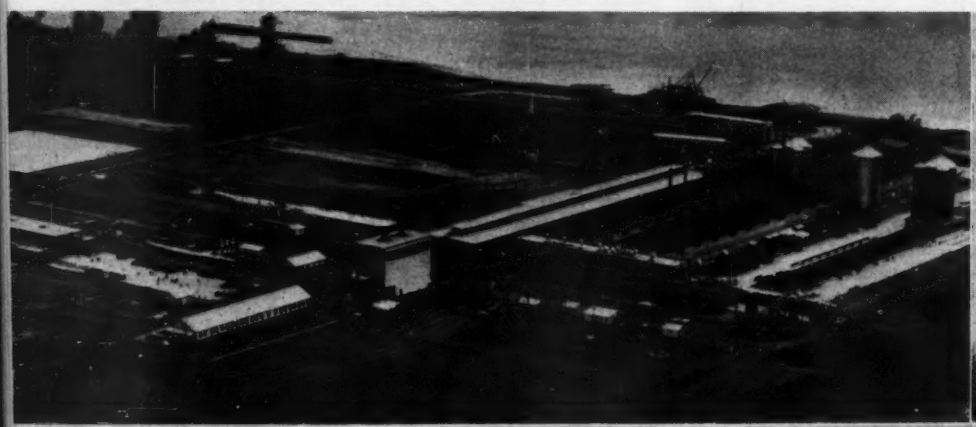
In northern Saskatchewan, the Box mine, on Lake Athabaska, is beginning to pay its way after the solution of several unique problems. Promising discoveries have been made in the Lac la Ronge area. Sodium sulphate, refractory clays, and briqueted lignite, produced in south central districts, are assuming greater economic importance, as are oil prospects and deposits of a type of extremely hard pebbles similar

(*Continued on page* 125)

Events and Personalities of 1940

Evidence of progress from the field

1. Production of aluminum was begun by Aluminum Company of America in this new plant at Vancouver, Wash., on Sept. 1, the initial capacity being 30,000,000 lb. of metal per year. On Nov. 29 the capacity was doubled and further expansion was begun to bring it up to 150,000,000 lb. per year. Power from Bonneville Dam is used. 2. Construction of the largest dragline in the United States (there is also another of the same size and a third is being built) was completed late in the year for the Dayton Dredging Co., at Dayton, Nev., by Bucyrus-Erie Co. It is of the walking type, has a 180-ft. boom and a 14-cu.yd. bucket. It will be used in mining gold. 3. The first power plant for the Yellowknife gold mining district, Northwest Territories, was erected by Consolidated Mining & Smelting Co. of Canada. This view shows the penstock and surge tank. 4. The electrolytic zinc plant of Evans-Wallower Zinc Co., at Monsanto, Ill., here shown, was purchased by American Zinc Co. of Illinois, wholly owned subsidiary of American Zinc, Lead and Smelting Co. It is being rehabilitated for production early in 1941. 5. Homestake Mining Co., at Lead, in the Black Hills of South Dakota, completed the new Yates shaft with equipment adequate for a depth of 5,000 ft. Named in honor of Bruce C. Yates, general manager for many years, this replaces the Ellison shaft. The shafthouse with its adjacent hoisting and other buildings is seen at the top of the picture in the center. 6. Commemorating the life of Dr. James Douglas, the James Douglas Memorial Building for Mines and Metallurgy, gift of the Phelps Dodge Corporation to the University of Arizona, was dedicated at Tucson on May 27 with fitting ceremony.



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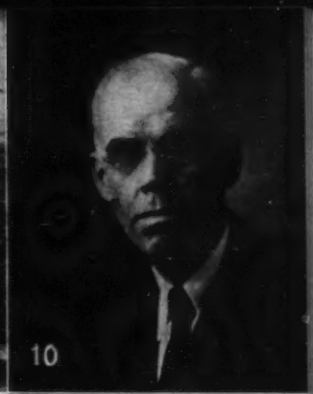
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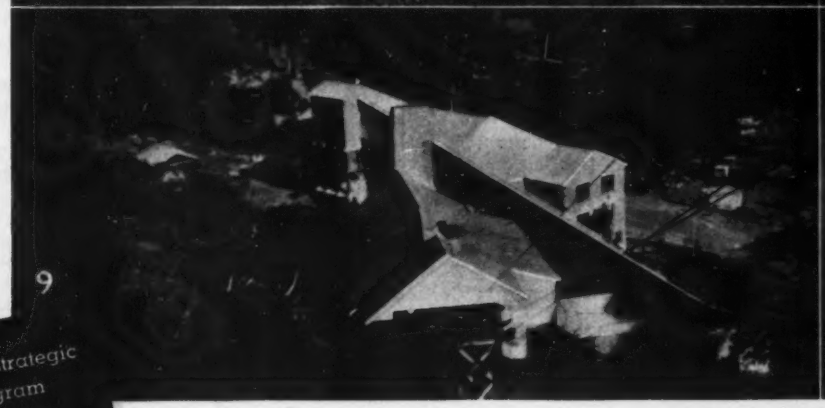
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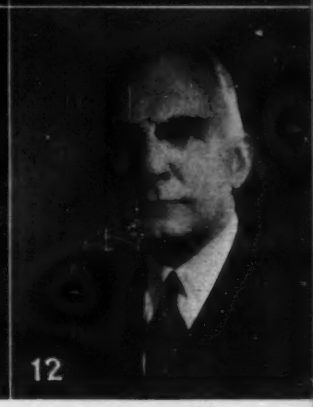
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Pursuit of the strategic minerals program

13

13. Clyde E. Williams, director of the Battelle Memorial Institute, Cleveland, Ohio, served as chairman of a special committee appointed by the National Academy of Scientists, through arrangement with the National Defense Advisory Commission, to review the many proposals for recovering manganese from low-grade ores.

Problems of providing adequate supplies of strategic minerals held the limelight throughout 1940, as in the latter half of 1939. As executive of the Government's program for attaining this objective, under E. R. Stettinius on the National Defense Advisory Commission, Dr. C. K. Leith (10) has rendered able service. Among those assisting him as specialists on various mineral commodities have been R. C. Allen (11) and Harris K. Masters (12). Among the numerous companies producing strategic metals are the Greenan Quicksilver, Inc., in the Battle Creek district, Nevada, which has erected a new plant (7); the New Almaden Corporation, producing quicksilver at Almaden, Calif., also with a new plant (8); and the Tungstar Corporation, 20 miles from Bishop, in Inyo County, California, which has built a concentrator for tungsten ore (9).

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14. Dr. R. R. Sayers was appointed Director of the Bureau of Mines, Washington, D. C., succeeding John Wellington Finch. Senior surgeon of the United States Public Health Service at the time of his appointment, he has been chief of the Bureau's health and safety branch from 1917 to 1932. The Bureau, with the Geological Survey, has had an important part in the strategic minerals program.

Mexico

Mining in the Republic is faced with serious problems owing to adverse conditions abroad and at home. Current optimism has little but hope thus far as basis

A. H. Hubbell
Associate Editor

DIFFICULTIES arising from the labor problem at home and the war abroad continued to beset the mining industry in Mexico in 1940. The results of the year confirmed the expectations of those who, at the declaration of war on Germany by Great Britain and France in the fall of 1939, had foreseen that the producers would be cut off from the European markets in which they customarily sold a good part of their copper, lead, and zinc. During the twelve months they saw their unsold stocks continue mounting. Despite this depressing circumstance, a certain optimism did indeed take hold in the latter part of 1940 following the accession of General Manuel Avila Camacho to the presidency, based on the hope that he would be more practical than his idealist predecessor and that the extreme radicalism of the preceding administration would be corrected gradually. The matter of payment for oil properties expropriated in March, 1938, though receding from the limelight with the lapse of time, remains vexatious, despite the fact that an agreement was reached between the Government and one of the petroleum producing interests involved.

The war is having a grave effect on the mining of certain metals in Mexico, with consequent impact upon the companies producing them, some of which are in bad straits on this account alone, to say nothing of the hardships imposed by the labor program. It is not enough for a company to produce—its output must be sold. Silver, fortunately for Mexico, which is the largest producer of this metal, has continued to flow to the United States Treasury through the latter's purchases on the New York market, the procedure followed being as explained in an earlier review.[1] Lead producers, however, have seen their stocks pile up. Before the war their main market was in Central Europe, now effectively cut off by the British blockade. A small part only of the surplus has been brought into the United States.

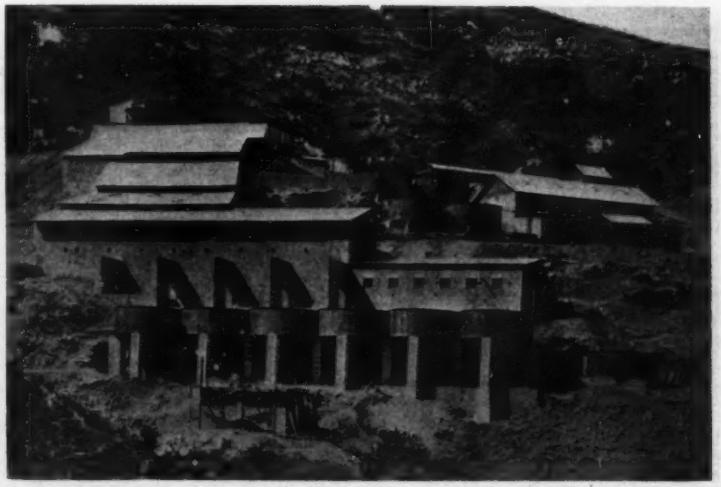
The greater part of Mexico's production of zinc finds a market normally in Europe, so that the producers have been seriously affected by the blockade. Very little of the output of zinc metal has come to this country, and some has gone to Japan. In the case of copper, the metal is usually sent to the United States in the unrefined state for refining in bond. The exact disposition of it subsequently is difficult to state, at least under the conditions prevailing. Output of quicksilver has been increased during the year, much of it being shipped to Japan.

For Mexico's output of the major metals in 1940 and 1939, reference may be made to the tabulations of world production given in the reviews of the respective metals that are presented in the preceding pages.

In proportion to its inability to sell abroad, the industry has not only seen its income shrink, but has lost much of the advantage it formerly realized from exchange. The value of the peso rose considerably in 1940, decreasing this advantage still further. From a low point of 15c. (U.S.) early in the year it reached a high of 21c. (U.S.) in the second half, creating new difficulties for the producers, who had seen salaries, commodity prices, and taxes adjusted upward because of the peso's previous decline,[2] but who could gain no equivalent relief when it rose again.

Labor has remained inefficient under the leadership that has so long dominated it. The year saw some serious strikes, the worst of which, affecting the coke supply of the smelters, is three months old at the time of writing in mid-January. Its prolongation will close these reduction plants within a few weeks at the latest, forcing thousands out of work, with consequent curtailment at the mines and depriving the small miners of a market for their ores. The miner's union, moreover, threatens a general strike if the companies involved do not accept the terms offered for new labor contracts. Wages in the Mexican mining industry are already high for the country—the average paid by certain important producers employing a total of 23,000 men being 8.84 pesos per day for the year. In view of the situation one must not take seriously the announcement made late in 1940 that a group of American promoters were contemplating important new investments in Mexico. Certainly the mining industry has not been considered for this purpose.

[1] *E.&M.J.*, Feb., 1939, p. 62.



One of the mills recently built with Mexico Government funds for small scale miners cooperatives. This cyanide unit in Guanajuato is called Planto Santo Nino

During the year, evil times indeed fell upon the cooperative mining societies composed of groups of Mexican laborers who would otherwise have been unemployed. Their general failure to achieve success even when favored by the government and by other circumstances is said to have cost them the esteem of the unions, who evidently dislike the idea of having to finance them. Some new societies were organized none the less, presumably by way of face-saving with the sponsors of this movement.

An effort to aid the small miner was made by the Department of National Economy in establishing several ore-treatment plants of small capacity at Tlalpuhajua and other points. Opinion varies as to the efficacy of this expedient. In official circles it is well regarded, but elsewhere it is looked on with skepticism.

Taxation underwent some changes, this in the appraisal of the value of certain metals for the 12 percent export tax. This tax was in effect removed with respect to silver and lead, on May 21 and Oct. 21 respectively. The respective appraisal values of copper, zinc, and gold were cut in half on the latter date. On the other hand, the "income tax on excess profits" created at the end of 1939, and retroactive with respect to 1939 operations, remained in effect in 1940. This touches all enterprises with over 5,000 pesos capitalization and showing profits exceeding 15 percent of their book worth, the tax ranging from 15 to 45 percent of the excess profits as defined by the law.

Transportation on Mexico's nationalized railway system has in the last few years been going from bad to worse under the management of the workmen. Income has been applied to raising wages instead of maintaining equipment in repair. In addition, efforts were being made to raise freight rates further. In consequence, the collapsing point had been approaching rapidly. Some remedy being imperative, the government at last stepped in and has undertaken a reorganization in an effort to lift the system out of its sorry state, which has been steadily worsening since the railroads were turned over to the workers. The representation of the government in the railway administration has been increased, giving it control.

Thus the picture presented by Mexico's mining industry in 1940 is rather worse than in the years immediately preceding. The economic position is decidedly so and the labor leaders are still unregenerate. Until substantial evidence of a friendlier attitude toward the industry is given by the new regime in Mexico City, it will be difficult to see good ground for optimism.

[2] This decline began in March, 1938, in the train of events that started with the appropriation of the oil properties.

South Africa

Gold production in 1940 broke monthly and annual records.

Large gold bearing reef proved in Orange Free State.

Maximum production maintained for other minerals

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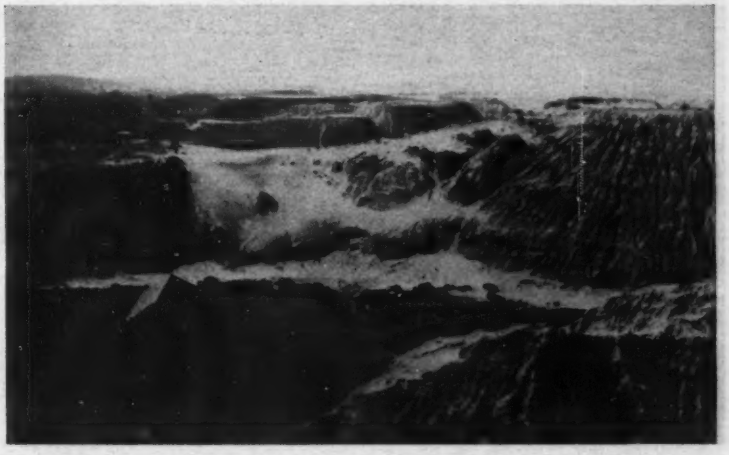
PROGRESS RECORDED in recent years has been well maintained during 1940, particularly in the gold-mining industry. Early in the year the basis of taxing the gold mines was changed and the industry was permitted to realize 168s. per fine ounce.

The government as well as the population fully appreciate the necessity for maximum production of all minerals, as well as of gold. Thus coal, tin, copper, chrome, and other mining operations have continued actively. World conditions have militated against advancement of the diamond-mining industry, with the result that only one of three producing mines at Kimberley was in operation during the year. The demand for diamonds has been below normal, although diamonds for industrial purposes have been disposed of in fair quantities. An interesting and important event has been the mining and recovery of mercury (quicksilver) on a small scale in the Northern Transvaal.

Although the gold-mining industry has gone from strength to strength, the upward trend of gold output is due to no special efforts on the part of the industry. As usual, every effort is made to raise efficiency continuously, but the peak of gold production appears to be a long way off.

A few of the older gold mines on the Witwatersrand will cease operations in the comparatively near future and others will begin to show signs of age. Leeway, however, will be more than made up by those mines that have recently entered the production stage; all these have long lives and some time must elapse before they get into their stride. Furthermore, some of the mines now in the development stage will join the list of producers, thereby swelling output still further.



An airplane view of the large eroded tailings dumps that mark the landscape near Johannesburg, South Africa

Table I—Results Achieved by Gold Mining Industry of the Rand and Its Extensions and Other Districts of the Transvaal in 1940

Item	January	February	March	April	May	June	July	August	September	October
Number of producing mines	43	43	43	43	43	43	43	44	44	44
Tons milled	5,148,800	4,963,400	5,187,800	5,292,300	5,500,300	5,336,900	5,530,250	5,578,600	5,414,000	5,643,500
Total fine ounces of gold	1,135,482	1,103,323	1,147,382	1,170,763	1,186,063	1,158,006	1,195,536	1,199,699	1,166,152	1,211,277
Pennyweights per ton	4.243	4.279	4.267	4.262	4.161	4.185	4.164	4.152	4.153	4.147
Declared revenue, total (£)	*	*	*	*	9,636,243	9,418,946	9,703,213	9,760,567	9,473,661	9,874,820
Declared revenue, per ton	.....	.....	.....	.....	35/1	35/3	35/1	35/	35/	35/
Total working costs (£)	*	*	*	*	5,703,183	5,541,640	5,696,212	5,711,107	5,544,521	5,705,207
Working costs per ton milled	.....	.....	.....	.....	20/9	20/9	20/7	20/6	20/6	20/6
Working cost per ounce produced	.....	.....	.....	.....	99/8	99/3	98/11	98/7	98/8	99/
Declared estimated working profit (£)	*	*	*	*	3,933,060	3,877,306	4,007,001	4,049,460	3,929,140	4,079,613
Declared working profit per ton milled	.....	.....	.....	.....	14/4	14/6	14/6	14/6	14/6	14/6
Number of Europeans employed	43,765	43,844	44,083	44,452	44,592	43,803	42,684	41,878	41,378	Not Available
Number of colored employees	315,046	337,164	350,103	358,055	360,330	359,419	355,749	354,830	359,718	
Wages and salaries, whites (£)	1,522,033	1,479,920	1,553,577	1,553,940	1,593,175	1,544,772	1,641,501	1,661,121	1,559,488	
Wages, colored (£)	951,171	944,076	1,024,334	1,042,090	1,084,377	1,015,644	1,068,212	1,075,396	1,021,099	

* Revenue, costs, and profit during the period Jan. 1 to April 30, 1940, were originally calculated on the basis of 150s per fine ounce, free of realization charges. Legislation passed in March provided that companies receive the full market price of gold less realization charges, the resulting profit being subject to amended taxation.

The following are the adjusted totals in respect of the six months January–June (individual particulars for January–June are not available):

Revenue: £56,164,326, equivalent to 35/9 per ton
Costs: £32,612,428, equivalent to 20/9 per ton
Profit: £23,551,898, equivalent to 15/ per ton

On this basis, the cost per fine ounce of gold produced during the first six months of 1940 was 98/1.

Conditions arising from the war have affected some developing properties adversely and some of them have ceased operations in consequence. In some instances, such properties have amalgamated with adjoining producing mines, while lack of funds and difficulty in raising more capital under present conditions will probably cause some of the others to await more propitious times before work in them can be resumed.

Of nine mines in the development stage at the end of 1939, four have suspended operations and one has commenced production in 1940. Apart from the four mines now in the development stage, there are two more potential large-scale producers, as yet not being developed, one on the Far East Rand and the other on the West Rand. Two of the developing mines are expected to reach the production stage before long, and a large area of auriferous ground has been proved in the Orange Free State. All these factors indicate further expansion of the industry.

Table I reflects results obtained to date in 1940, and for comparison, the revised 1939 results are included.

The table shows that only one mine joined the list of producers in 1940. Included in the table is the gold won from miscellaneous mines (Witwatersrand) as well as from other districts in the Transvaal. The monthly total from the latter sources averaged 41,976 fine ounces, with minimum and maximum totals of 40,692 and 44,192 fine ounces respectively.

Other features are the relatively constant value (pennyweights) per ton milled, the uniform monthly revenue per ton, profit per ton, and working cost per ounce of gold produced.

For the first time, monthly production has reached 1,200,000 oz. As in 1939, many records were established during the year by individual companies and by the industry as a whole. During the ten months under review, 11,673,683 fine ounces of gold were produced, equivalent to 14,008,420 oz. for the whole year. This figure compares with 12,352,099 oz. produced during 1939. It is estimated that last year the Transvaal contributed 32.7 percent of the world's newly mined gold. The basic policy is still being followed of keeping down the grade of ore mined with the view to prolonging the life of the industry and

Milling and cyanide plant of Geduld Proprietary Mine, Ltd., in South Africa, that treated 1,365,000 tons of gold ore during the year

consistent with yielding adequate returns on money invested.

Improved results have been obtained with the employment of fewer Europeans and more colored employees, due partly to increased mechanization, improved operating practice, and to a large extent to the closing of developing mines the labor complements of which were included in the results tabulated.

It is noteworthy, too, that footage sunk in main shafts in 1940, as well as footage developed, approximates the figures for 1939, despite the fact that some non-producers have suspended operations.

The usual research to improve results and working conditions continues unabated. The dust problem is growing less serious with the passage of time, and great advances are expected from decisions made to equip more mines with additional air-cooling and conditioning plants. Detachable bits are coming into more general use; the causes of rock-bursts have been the subject of much study; stoping methods in some mines are being changed to suit increasingly difficult conditions due to great depth; and, in brief, every phase of mining and reduction activity is being studied assiduously.

It is gratifying to note that notwithstanding the large native labor force, involving the employment of many raw or formerly untrained natives, the accident death rate per 1,000 per annum, which in 1939 was 1.83, continued to decrease. This compares favorably with similar figures for mining operations in other parts of the world.

It has been customary for mines, in specific instances, to link part of their ventilation system with that of an adjoining mine. In one case, two adjacent mines jointly sank a shaft on a common boundary so as to assist partially the ventilation systems of both. A recent arrangement provides for the sinking of a ventilation shaft at a point common to four mines—namely, Daggafontein, East Geduld, Grootvlei, and Springs Mines. This (circular) shaft will be 3,180 ft. deep and will have a diameter throughout of 23 ft. Each mine is to upcast 250,000 cu.ft. of air per minute, measured underground, equivalent to a total of 1,130,000 cu. ft. on the surface. The scheme, as originally designed, required the use of a Walker fan, situated at the surface, that would operate at a water gage of 9 in., and a standby fan having ¾ capacity of the main unit. The fans will be on the surface. The latter will be the largest single unit in the world, and conditions arising from the war may necessitate its construction in South Africa. Of the mines participating in the scheme, two are controlled by one mining house and two by another.

Australia

Taxation of gold modified by the government to encourage increased production. Aluminum and magnesium may be produced in the Commonwealth in the near future

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Melbourne, Australia

THE HISTORY of Australian mining during 1940 has not been marked by the discovery of any new mineral deposit of importance outside the known fields. Gold production has been well maintained by all existing mines, and continued search has been directed to the discovery of new mines or to the acquisition of abandoned properties which offer prospects of successful reopening under existing conditions. The recently passed Gold Mining Encouragement Bill, by modifying the conditions governing taxation of the gold-mining industry, gives relief to mines operating on a small profit margin, which in general are low-grade deposits. The effect of the original taxation was to reduce the price of gold to the producer by about 16s. per oz. This new act provides that the government will refund the amount by which the cost of production of gold exceeds a basic amount which is defined as the amount paid by the bank, less the amount of the tax, and less 30s. per fine ounce. With gold at £10 10s. per fine ounce, this basic amount becomes £8 5s. Thus all companies producing gold at approximately £9 per fine ounce or more will, in effect, be exempt. It is expected that the exploitation of low-grade ore bodies will be encouraged.

For the purpose of safeguarding gold production during the war, gold mining has been declared a reserved occupation, and enlistment of skilled labor from among mine workers will be controlled. Development in certain of the large gold mines is tending to increase ore reserves by the inclusion of ore which previously would have been below the economic limit: greater tonnage in ore reserves of reduced grade is thus becoming apparent.

In base-metal mining, increasing attention is being given to extending the production of copper. A greater output of tin is expected from plant extensions at lode and alluvial mines, and interest is being shown in the reopening of idle properties.

Wolfram production remains steady. An increased output of antimony is probable, and the production of aluminum and magnesium in the Commonwealth may be commenced in the near future.

It has been considered advisable by the Commonwealth Government to omit publication of base-metal production statistics, so figures relating to output are not available this year.

WESTERN AUSTRALIA—Statistics to the end of October disclose a production of 1,010,734 oz. gold for that part of the year, compared with 1,002,514 oz. for the corresponding period in 1939. Gold production on the Kalgoorlie field continues at a rate comparable to that of the previous year. Lake View & Star, Ltd., maintains production at close to 60,000 short tons of ore per month, and the re-treatment plants put through 50,000 tons of dump material monthly. A new plant has commenced work on the 4,000,000-ton dump on the old Chaffers-Lake View leases, which has a monthly capacity of 60,000 tons. Development work is satisfactory, and a new lode, 60 ft. wide, is reported to have been located in crosscutting, in virgin ground, at the 2,650-ft. level. Great Boulder Proprietary Gold Mines continued to increase ore reserves over and above the requirements of the 40,000 tons per month capacity plant. On the Boulder Perseverance mine, the long-range development policy on the Enterprise section, of crosscutting from the Perseverance workings at a depth of 2,000 ft. or 500 ft. under the lowest Enterprise workings, has proved quite successful.

North Kalgurli (1912), Ltd., has maintained its sound development and production position, and has increased ore reserves to 835,000 tons assaying 7.3 dwt. On the company's Croesus Proprietary lease, the new 7,000 ton per month treatment plant has been completed. Gold Mines of Kalgoorlie, Ltd., produced 116,000 tons of ore for the financial year, and ore reserves are 657,000 tons. On the mine of Paringa Mining & Exploration Co., Ltd., diamond drilling below the 640-ft. level continues to disclose ore of good width and grade. The youngest venture on the Kalgoorlie field, Mount Charlotte (Kalgoorlie) Gold Mines, Ltd., has commenced work on the old Hannan's Hill leases, which have been idle for 30 years, and in which large bodies of low-grade ore have been located by diamond drilling to a depth of 1,000 ft.

In metallurgical practice on the field, increasing attention is being given to temperature control during roasting, and precyanidation, or cyanidation prior to flotation concentration, is increasing in favor.

Among the outside fields, Norseman shows considerable promise. The small Blue Bird mine milled 1,797 tons of ore from above the 200-ft. level, for a return of 8,125 oz. of gold, and has reserves of 11,000 tons. On the property of Central Norseman Gold Corporation, Ltd., a new vertical main shaft is being sunk to 2,200 ft., and during the financial year the company completed 13,817 ft. of development work and 12,212 ft. of diamond drilling. The average grade of ore milled was 8.54 dwt. gold per ton. At Gwalia, the main shaft of Sons of Gwalia, Ltd., has been sunk to an incline depth of 5,036 ft. Ore reserves of 6.24 dwt. per ton grade continue at six years. Ore milled for the year was 152,448 tons for 45,485 oz. of fine gold, the recovery being 92.3 per cent.

Development work at Wiluna Gold Mines, Ltd., failed to open up any material tonnage of ore. Exploratory work is to be limited, and further capital expenditure restricted. Among lesser deposits, Blue Spec Mines, N.L., are developing auriferous antimonial ore, worth 18 dwt. per ton at Nullagine, and there is prospect of developing similar ore on several neighboring leases.

NEW SOUTH WALES—At Broken Hill, the Sulphide Corporation, having practically exhausted ore reserves, has ceased operations. On the North Broken Hill mine, development continues to increase ore reserves. No. 2 shaft was sunk to a depth of 2,731 ft. and at the 2,450 ft. level the length of the southern orebody has been proved to be 473 ft. with a width of 150 ft. Recoveries in the new mill, in which treatment practice combines jigging, tabling, and flotation, were lead 95.5 per cent, silver 88.1 per cent, and zinc 86.5 per cent. In the Broken Hill South mill, in which similar practice is followed, recoveries were lead 96.1 per cent, silver 91.5 per cent, and zinc 88.7 per cent. Lead concentrate assayed 77.3 per cent lead and the zinc content of the zinc concentrate was 52.8 per cent. Milling practice on Zinc Corporation, Ltd., is all-flotation for both lead and zinc. The new mill, which has a capacity of 10,000 tons of ore per week, is an outstanding metallurgical development in simplicity of operation and layout. Recoveries are: lead 96.4 per cent, silver 93.9 per cent, and zinc 87.5 per cent.

On the New Broken Hill Consolidated, Ltd., property, which adjoins the Zinc Corporation on the south, and is managed by that company, diamond drilling continues to disclose ore of good value and considerable width. Sinking of the circular air shaft is progressing and mining operations will be carried out from the Freeman shaft of Zinc Corporation, Ltd.

At Cobar, New Occidental Gold Mines report ore reserves above a depth of 1,600 ft. at 960,000 tons of approximately 8 dwt. per ton grade. In the New Cobar section, the average grade of ore is 7.84 dwt. gold and 0.89 percent copper. New Occidental ore is treated by fine grinding and cyanidation, but owing to the copper content in the New Cobar ore, an auriferous copper concentrate is produced by flotation. Both mines are developing well.

The 14-cu. ft. bucket dredge of Wellington Alluvials, Ltd., maintains an output of about 8,000,000 cu. yd. per annum of ground averaging 2.3 gr. per cu. yd.

VICTORIA—The outstanding feature of mining in this State has been the expansion of operations on the Bendigo gold field, which after 90 years' operation is now producing at the rate of 70,000 oz. of gold per year. The deposits on the Deborah anticline continue to yield important returns to operating companies, the North Deborah mine, with an output of 850 tons of ore per month, being conspicuous with the payment of £115,000 in dividends over a period of 15 months.

At the close of the year, 12 companies are shaft sinking on the field, and increasing attention is being given to extensions of productive lines of reef. Bendigo ore is free-milling and treatment is simple, over 90 percent of the gold being recovered by amalgamation supplemented to a small extent by concentration. On the neighboring Chewton field, Wattle Gully Gold Mines is milling at the rate of 30,000 tons of ore per annum, having an assay value of 7.5 dwt. gold per ton. The lowest level is 9,000 ft. from surface and the orebody, which has a length of 400 ft., varies in width from 10 ft. to 40 ft.

A mine of promise is worked by the Maxwell Consolidated company at Daylesford. From a flat lode at 600 ft. from surface, ore worth 14 dwt. gold per ton is being produced, and the company has paid regular dividends.

In alluvial mining, Victoria Gold Dredging Co., Ltd., at Newstead, dredged 2,286,000 cu. yd. during the last financial year for a recovery of 20,692 fine ounces of gold. Total operating costs were 3.68 pence per cubic yard. Resoiling is practiced, and the re-made ground is in excellent condition for agriculture.

The most recent dredging undertaking is that of Harrietville (Tronoh), Ltd. The property contains 96,000,000 cu. yd. of alluvial worth 1.9 gr. gold per cubic yard, and is being equipped with a 20-cu.ft. bucket dredge.

QUEENSLAND—Mt. Morgan, Ltd., earned larger profits for the year, and effected a substantial reduction in working costs to 10s. 10d. per ton of ore mined. Ore is won by open cut by means of power shovels with electric locomotive and motor transport delivering through a transfer pass to crushing stations at the 450-ft. and 650-ft. levels, whence ore is hauled to surface. The ratio of overburden to ore is 1.78 to 1. Mill capacity has been increased by the conversion of half the oxide mill into a sulphide treatment plant. The auriferous copper concentrate is roasted in Edwards duplex furnaces and is smelted in a coal-fired, reverberatory furnace with a smelting chamber 38 ft. 6 in. long, and 15 ft. 6 in. wide, preceded by a pre-ignition chamber. The converter is of the Great Falls type. Consideration is being given to the erection of a copper refinery on the mine, and the production and disposal of pyritic concentrate for sale to sulphur users is receiving attention.

The Golden Plateau mine milled 79,035 tons of ore during 1940 for the recovery of 22,676 oz. of gold. The main shaft has been sunk to 644 ft. from surface and exploratory work is proceeding at that depth. The western section of the mine has proved disappointing and development generally has not produced sufficient ore to balance production. Ore reserves are 175,100 tons, estimated to contain 43,185 oz. of gold.

On the 1,600-acre property of Tableland Tin Dredging at Mt. Garnet, No. 1 bucket dredge is digging at the rate of 70,000 cu. yd. per month, the yield being approximately 12 oz. of tin oxide per cubic yard. A second dredge having a capacity of 4,000,000 cu. yd. per year is under construction. The company's property is estimated to contain 100,000,000 cu. yd. of workable ground. There is marked activity in lode tin mining by small mining

groups and working parties, and the search for wolfram is stimulating the production of that metal. Mt. Isa lead-zinc mines operated throughout 1940.

TASMANIA—The three large mining undertakings in the state are Mt. Lyell (copper), Briseis (tin) and the Electrolytic Zinc Company's lead-zinc mines at Rosebery. Operations at Mt. Lyell have been marked by the expansion of open-cut mining operations which now supply the greater part of the daily production of 3,600 tons of milling ore. Recent additions to the mining plant are 20-ton capacity semi-trailers, transporting ore between the power shovels and the transfer pass to the North Lyell tunnel, through which the ore is hauled to the mill. Considerable rearrangement has been effected in mill and smelter and the company has completed a profitable year.

Briseis Consolidated sluiced 741,000 cu. yd. of drift during the last operating year for 505 tons of tin oxide, an average of 1.5 lb. per cubic yard. The stanniferous drift is 400 ft. wide and 250 ft. deep, and is covered by 150 ft. of hard basalt overburden, which is undermined, broken, and removed by sluicing. Costs, including overburden removal, are 16d. per cubic yard. The principal producers of lode tin are the Aberfoyle and Storey's Creek mines, where cassiterite occurs in association with wolfram. Scheelite is being produced in important quantity by open-cut mining on King Island. The important tin-producing states, in order of output, are Tasmania, New South Wales, and Queensland.

NEW GUINEA—For nine months of 1940, Bulolo Gold Dredging, Ltd., operating eight dredges, dug 12,247,000 cu. yd. for a yield of 126,951 oz. of gold, equivalent to 4.75 gr. per cubic yard. An interim dividend of 150 Canadian cents per share was paid in June. Reserves of dredgeable ground at May 31, were estimated at 164,000,000 cu. yd. and 20,000,000 cu. yd. suitable for hydraulic mining. Consistent production is maintained by Cuthbert's Misima Goldmine, Ltd. During the four years of operations, 118,175 tons of ore have been mined and ore reserves have steadily increased to 194,000 tons. For the expired portion of the year, 28,159 tons of ore have been milled for a recovery of 6,826 oz. of gold and 22,138 oz. of silver, the average value per ton of ore being 39s. 7d.

At the property of New Guinea Goldfields, Ltd., there has been increased development and prospecting. At the Edie mine, development has not kept pace with extraction, but ore reserves at Upper Ridges and Anderson's Creek have been substantially increased.

The Philippines

Mining industry enjoyed a steady growth in 1940, ninety percent of the total value being in gold and the remainder in base metals. Efficiency of industry steadily being improved

Ralph Keeler
Manila, P. I.

THREATS OF WAR and unsettled political conditions did not stop the steady growth of the Philippine mining industry during 1940. The industry produced metals valued at some 90,000,000 pesos, of which almost 80,000,000 pesos was gold and the rest base metals, chiefly iron. There was nothing spectacular about the increase in gold output—around 7 percent, compared to 1939. The vital facts about Philippine gold mining are these: Gold mining for the past two years has been settling down to a program of increasing plant efficiency and of developing ore reserves with the view of the most economic exploitation of available minerals. So far none of the leading producers have bottomed their ore reserves; thus many years of continued operation are assured if political conditions permit.

Two new districts opened up during October—in the subprovince of Kalinga, some 125 miles north of Baguio, the Batong-Buhay Gold Mines, a Soriano operation; and in Davao, at the southern end of Mindanao, the Davao Gold Mines, an Elizalde undertaking. Both of these areas are virgin territory in so far as gold mining is concerned; to date there are no indications that other producers will be developed in either district. Both mines are small operations, Batong-Buhay running a 100-ton flotation plant and the Davao mill being a 150-ton flotation-cyanidation operation. Both are in inaccessible locations, necessitating the building of roads, and in the case of Davao Gold, aërial freight transportation followed by a 13-km. aërial tramway. The fact that these two operations were started and carried through to production after interest in the mining share market had faded, and at a time when conditions in the Philippines and in the Far East did not encourage the investment of funds in new enterprises, is an indication of the faith of two of the largest organizations in the Orient—the Soriano and Elizalde groups—in the future of the Islands. It is also further proof that there are yet mines to be found in the Islands—neither of these two new mines received attention during the 1933 and 1936 mining booms.

Stockholders in Philippine mines received more than 19,500,000 pesos during the year in dividends—about 24 percent of the entire output of the industry. This is lower than the 1939 figure by about 30 percent—heavy stocks of supplies and higher operating costs all-round—but still represents good return from mines for the most part still only a few years old.

As has been the case since modern mining has been going on in the Islands, the mining share market has not fallen in line with the progress of the industry. Today there is practically no interest on the part of the general public in the mining share market. During the month of November the total value of mining shares sold was only 1,245,948 pesos; during the heyday of mining share speculation in Manila (and at a time when there were but a handful of gold producers and fewer still in the dividend-paying class) there were many million-peso days! During the entire year of 1940 the mining shares traded were not valued at much over 21,000,000 pesos—and most of this business was between brokers and a few large shareholders.

The relative standing of the various groups as to output and dividends remains the same. The Benguet group—Benguet Consolidated, Balatoc, Cal Horr, Ipo Gold—accounted for around 35 percent of the total gold production; the Marsman mines—Itogon,

Table I—Philippine Gold Production

	1940, Pesos	1939, Pesos
Antamok (a)	2,615,000	3,151,000
Baguio Gold	2,214,000	1,843,000
Balatoc (b)	13,417,000	12,429,000
Benguet Consol. (b)	13,279,000	11,425,000
Benguet Exploration	.....	10,000
Benguet Goldfields	634,000	110,000
Big Wedge	2,046,000	1,905,000
Cal Horr (b)	1,446,000	1,425,000
Capsay	1,282,000	1,231,000
Coco Grove (c) (d)	1,661,000	2,192,000
Crown Mines	132,000	80,000
Demonstration	490,000	1,150,000
East Mindanao	734,000	675,000
Gold Creek	154,000	120,000
Ipo Gold (b)	721,000	1,290,000
Itogon (c)	5,365,000	4,625,000
I.X.L. (a)	3,076,000	3,075,000
Km 73	164,000	510,000
Macawiwili	439,000	400,000
Mapaso	62,000	27,000
Mambulao (a)	.....	340,000
Masbate Consol. (a)	6,309,000	5,000,000
Masbate Goldfields	.....	250,000
Mindanao Mining	85,000	125,000
Mindanao Mother Lode	2,192,000	1,435,000
Mineral Resources	410,000	130,000
North Camarines (a)	1,564,000	1,865,000
North Mindanao (d)	95,000	110,000
Northern Mines	667,000	495,000
Paracale Gumaus	1,858,000	1,130,000
Paracale Mining	80,000	120,000
Paracale National	346,000	180,000
Royal Paracale (c)	.....	265,000
San Mauricio (c)	6,019,000	6,515,000
Sta. Ana Sn. Joaquin	.....	67,000
Santa Rosa	930,000	951,000
Surigao Consol.	2,186,000	1,285,000
Suyoc Consol. (c)	1,980,000	1,631,000
Tambis Gold (d)	120,000	100,000
Tap-an Surigao	.....	60,000
Tinago	.....	70,000
Treasure Island	1,463,000	550,000
Twin Rivers (c)	21,000	254,000
United Paracale (c)	3,248,000	2,920,000
Totals	79,524,000	73,521,000

(a) Operated by Soriano interests. (b) Operated by Benguet Consolidated interests. (c) Operated by Marsman interests (d) Placer operation. (e) Tailings plant.

Suyoc Consolidated, United Paracale, San Mauricio, Coco Grove, Tuba Mines—for 24 percent; the Soriano mines—Antamok Goldfields, Masbate Consolidated, I. X. L., North Camarines—for 18 percent. This ratio will probably continue for some time.

Increased freight rates have naturally raised operating costs, but not to the point of cutting margins of profit seriously.

Base metals still depend upon the Japanese market to a great extent, although there has naturally been, with the United States rearmament program, an increased interest in Philippine manganese and chrome. The iron-ore industry is sending nearly 100,000 tons of ore monthly to Japanese smelters. This export business will continue as long as funds are forthcoming from Japan to pay for it (which will probably be indefinitely in view of the acute need of Japan for iron) and as long as the United States doesn't impose an embargo on such shipments (which will depend upon just how strained relations between the United States and Japan become). The increase in value of base-metal exports from some 10,000,000 pesos in 1939 to 14,000,000 pesos in 1940 reflects higher prices rather than more tonnage. This increase, based as it is on war demand, cannot be taken as a normal indication of trend.

All in all, 1940 was a banner year for Philippine mining; and 1941 should see the same pace maintained, with steady but possibly somewhat slighter increases recorded. Operating conditions in the Islands were excellent throughout the year, from every standpoint. There were no seriously severe typhoons affecting the large districts (although considerable damage was done to the Treasure Island mill, on Lahuy Island, during the late fall). Labor conditions were about normal, there being no particular differences between the mining companies and the workers. The government worked well with the industry; in fact, the withdrawal of four gold-bearing properties from public lands by President Quezon in September will stimulate the opening up of new properties. Some 750,000 pesos is being spent by the government in oil survey and drilling work in various parts of the Islands, and private enterprise is being encouraged to go ahead with oil exploration projects. No results have been reported, and reports over the past years by competent authorities have not indicated that oil exists in any commercial quantities in the Archipelago.

Politically, the very definite move towards a reconsideration of the terms of the Independence Act is interpreted favorably by the mining leaders, bringing as it does a more favorable feeling towards American business enterprises than existed during the first flush of the nationalistic feeling which followed the inauguration of the Commonwealth. The gist of the situation is that the Filipinos are realizing that the way of the small nation alone is hard—especially when the small nation has been under the benevolent protection of Uncle Sam for 40 years. A move towards a favorable adjustment (favorable to the Islands, of course) of conditions is well under way. How it will fare in Washington is a matter of some concern to the Filipino leaders.

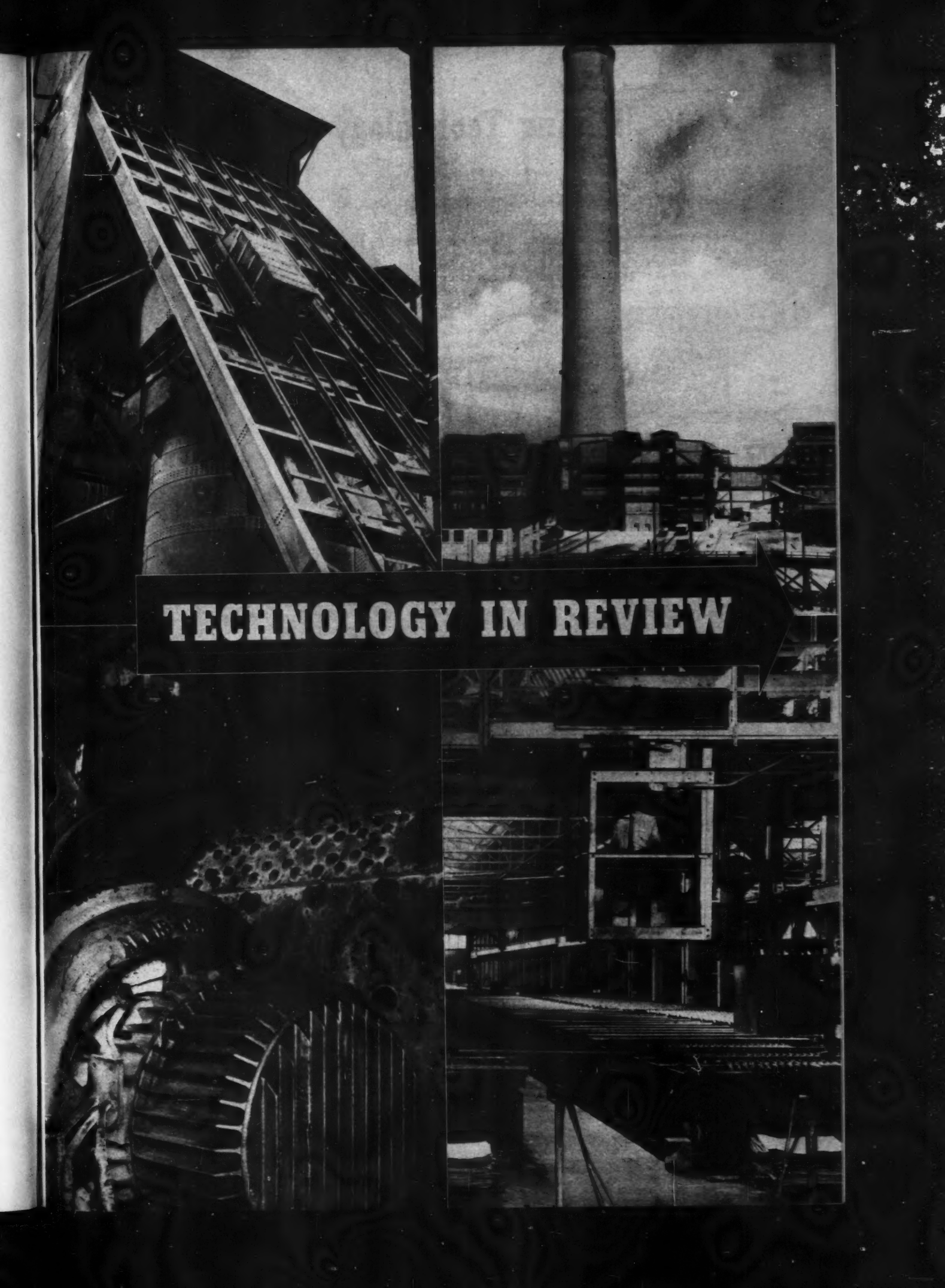
The Philippine Islands have felt the effects of the present wars far less than almost any other country in the world; and unless relations between the United States and Japan are strained to the breaking point, this happy condition will probably continue.

Table II—Dividends Paid by Philippine Mining Companies

	1940 Per Share, Pesos	1940 Total Amt., Pesos	1939 Per Share, Pesos	1939 Total Amt., Pesos
Antamok	0.01	275,000	0.035	962,500
Atok (a)	0.04	400,000	0.06	600,000
Baguio Gold	0.03	389,700	0.02	259,980
Balatoc	0.70	4,200,000	0.80	4,800,000
Benguet Consolidated	0.65	7,800,000	0.85	10,200,000
Big Wedge	0.04	311,077	0.04	311,077
Coco Grove	.015	225,000	0.02	300,000
East Mindanao	0.01	100,000	.....	.....
Eastern Development (a)	.....	.....	0.001	111,500
Hixbar	0.03(b)	164,616	0.04	819,568
Ipo	.....	.....	0.025	224,950
Itogon	0.04	1,000,000	0.04	1,000,000
I.X.L.	0.08	1,200,000	0.09	1,350,000
Lepanto	0.035	612,500	0.005	52,500
Marsman Common (a)	0.08	150,448	0.08	150,448
Marsman Preferred (a)	.....	.....	0.08	150,448
Nielson	.....	.....	0.005	75,000
Paracale Gumaus	0.045	225,000	0.005	25,000
Philippine Iron Common	5.00	200,000	10.00	400,000
Philippine Iron Preferred	.....	.....	0.20	19,567
San Mauricio	0.07	1,400,000	0.135	2,700,000
Surigao Consolidated	0.04	409,360	0.01	102,297
Suyoc Consolidated	0.015	187,500	0.01	125,000
Tambis	.....	.....	0.005	19,679
United Paracale	0.02	260,000	0.04	520,000
Totals		19,510,201		25,279,514

(a) Mines Management Company. (b) Plus 0.05 pesos per share return on capital paid Aug. 1940.

Native girls become expert ore sorters at several mining properties in the Philippines.


TECHNOLOGY IN REVIEW

Mining Technology

Dredging, open pit and underground mining reflect improved efficiency from better equipment. Revolutionary drilling practices and mechanized loading highlight some 1940 operations.

George J. Young
Consulting Editor

WORLD EVENTS and domestic affairs profoundly influence the mining industries and are a factor in modifying current technological practices. Taxes, Federal and local, regulations of many kinds and the surcharging of the manufacturing industries with war work will add to the responsibilities of mining managements in no uncertain way. However, the industry has coped with adverse conditions time and again and is fully competent to do so now.

Light alloys, stronger steels, abrasion- and corrosion-resistant alloys influence mechanical design in machines used by the mining industries. They are not altogether new. Miners have always sought for better materials. Weight has been reduced by the use of stronger metals and by smaller sections. Better mechanical design is more readily obtainable. The miner has supplied iron, nickel, manganese, tungsten, cobalt, chromium, and molybdenum ores. The steel maker has devised many alloys having a variety of properties. On the other hand, the miner has utilized these alloys in his equipment and structures wherever advantage appeared. Better, stronger, and more efficient machines were never more available than at present.

Two descriptive papers about mining practice in two important localities are worth mention. Thomas Pryor, in his presidential address before the Institution of Mining and Metallurgy (London)[1] gives salient features of the history and practice in the Kolar gold field of India. This area was commercially started circa 1880 by the Mysore Company and since that time four principal companies reached mining depths of 7,913, 8,131, 8,603, and 7,108 ft. in 1939; gross production totals 18½ million ounces of gold from 28¼ million tons of ore.

Important problems of mining at such great depths are control of humidity, temperature, and rapid wall-rock movement. Vertical timbered shafts were sunk to 2,000 ft. and below this depth development was effected by internal shafts, in the hanging or footwalls at some distance from the lode. Subsequently the development comprised 4,000-ft. vertical shafts from the surface, followed by internal second-stage vertical shafts to serve the next 3,000 to 4,000 ft. of depth. At the end of 1939 there were six deep shafts from surface, five brick-lined circular shafts, 18 ft. in diameter, and one rectangular timbered shaft. Total tonnage milled is about 2,800 tons per day, or about 800,000 tons per year. Shafts of large size were selected to provide adequate ventilation. The temperature gradient is one degree F. per 111 ft. in the deeper levels. The 4,000-ft. shafts are each equipped with one hoist for cage service. An elliptical shaft section is used for the internal shafts. Timbering has been discarded in favor of concrete or brick. Brick lining is 18 in. in thickness and concrete is employed in like manner.

At the Champion Reef mine the main working shaft has been deepened to the 70th level and a new engine installed to hoist in one lift of 6,556 ft., a load of 5 tons of ore. Cages are of duralumin. From the shaft bottom crosscuts connect with drifts and three concrete-lined internal shafts of elliptical sections to serve a lode length of 3,550 ft. to an ultimate depth of 10,000 ft.

High rock and air temperatures make wet drilling impracticable. Reciprocating drills are employed in drifting; jackhammers in shaft and winzes and cradle-mounted hammer drills in machine stopes; air pressures are 60 lb. p.s.i. In driving levels average advance is 60 ft. per month and in machine stopes 4.5 tons are broken per machine shift. Hand labor is used for 60 per cent of the ore broken in stopes and is 18 per cent cheaper than by machine under Kolar conditions.

Rock-bursts in varying degree interfere with normal stoping operations. These became conspicuous when 4,000-ft. depth was reached in 1914. Timber supports plus waste-rock fill proved insufficient and in 1927 P. J. Crowle introduced more rigid stope support by means of granite blocks sent down from surface. Open stope space was restricted by closely following mining with granite block walling. Annual tonnage of granite blocks increased from 12,000 in 1933 to 120,000 in 1939. Support for levels and ladderways was improved by supplanting rigid concrete lining with sets of steel rails, bent to form oval-shaped traveling ways, each set being surrounded by a cushion of compressible packing while the stopes above and below were supported by as rigid packing (granite blocks) as possible.

Pumping is not of great importance but ventilation is critical. Mean rock temperatures are 81.6 deg. F. at the surface and 134 deg. F. at a vertical depth of 8,000 ft. Natural ventilation with ample shaft and connection cross-sections answered to 4,000 ft. in depth, but during hot weather conditions underground were trying. The first underground fan was installed in 1912; by 1920 at a depth of 5,000 ft. increased fan ventilation answered, but by 1937 air conditioning became necessary, and in 1938 a surface refrigeration plant was installed at the Ooregum mine. This improved working conditions and other mines in the district will install similar plants.

Deep mine operation under tropical conditions with native labor is surveyed by Thomas Pryor. In sharp contrast are the conditions at the Hollinger mine, in Canada, which are described by J. W. Dougherty and J. M. Douglas.[2] The ore zone has a length of 6,000 ft. and a width of 4,000 ft. Many orebodies are worked, varying in ore width from 1 ft. to 75 ft. and averaging about 10 ft. The mine is served by four surface and three internal shafts. The central shaft is 3,158 ft. in depth; No. 19 shaft is 3,950 ft. in depth; No. 25 shaft, an internal, serves the 5,150-ft. level. All shafts are timbered. Skip hoisting for ore and cages for men and material are standard. Ore is handled by a system of transfers from various levels to main loading stations, so that hoisting is concentrated at a few points. Other features are nickel-chrome steel cages; use of treated timber; composite timber and steel shaft support; V-beam copper-bearing galvanized-iron sheets for shaft lining; haulage drifts and cross-

cuts 8.5 ft. high and 7 ft. wide with safety bays at 50-ft. intervals; burn-cut rounds in blasting raises and drifts; 250,000 ft. of diamond drilling per annum for exploration; drifters with dustless front ends and oversize water tubes; use of Stellite for restoring worn rock-drill parts as well as chromium plating for worn rock-drill cylinders; 3/32-in. gage changes for rock-drill bits; electric cap lamps; use of respirators for men engaged in chute pulling, raising, and sampling.

At Kolar 8,000 surface and 15,000 underground employees produce and mill daily 2,800 tons of mill ore, while at Hollinger 1,960 men are employed daily breaking 5,500 tons of ore, and 1,550 tons of waste rock.

ALLUVIAL MINING—Great activity marked alluvial gold mining and especially dredging. Some minor improvements have been made in practices such as the molded rubber riffles installed in larger dredges. Continuous bucket dredges are better designed to meet individual conditions; oversize operating parts are being used to cope with hard digging and bouldery ground as well as for deeper work. Such dredges cost more but are more efficient. Yuba constructed seven continuous bucket dredges in 1938, six in 1939, and about the same number in 1940. For large dredging areas of from 20 to 110 ft. below pond level, continuous bucket dredges are almost exclusively used.

Great interest is being taken in small properties and the number of dragline dredges has increased, with probably a greater proportion of successes than in the past. Operators favor the use of the dragline scraper and floating barge with washing plant for these small areas and for shallow digging. Some notably large operations of this class have been started, one handling, 7,000 cu.yd. per day. Greater attention is being paid to design and construction, and operators have gained more experience. Charles Thurman states that cleaner bedrock can be obtained by bucketing from different directions and suggests that the bucket be dumped at each pass or swing rather than drag it back and forth until filled. Thurman gives approximate costs for one year's operation of a dragline dredge as 15.14c per cubic yard; capital for 2-yd. excavator, 1.5-cu.yd. bucket, washing plant and other facilities as $74,500; annual yardage 744,583; per day 2,051 cu.yd. and running time 63.39 per cent.

OPEN PIT MINING—Three open-pit copper mines were described,[3] Chino, Morenci, and New Cornelia. A composite picture shows ratios of overburden to ore from 1.0 to 1.2; all primary drilling by electric churn drills; 9-in. blast holes on benches from 20 to 50 ft. in height; Primacord with various types of explosives and hole spacing to suit individual conditions; toe-holing and secondary drilling by hammer drills and the general use of detachable bits; some tripod and wagon-type drills are used at New Cornelia on ore banks less than 20 ft. in height. Electric blasting is used in such bank blasting. Ore and waste rock loading is by electric power shovels, full revolving, caterpillar traction. Sizes are 4 cu.yd. to 8, the size most used being 4.5 cu.yd. Track and locomotive transportation rules, except in preliminary work at Morenci, where a fleet of 22.5-cu.yd. diesel trucks was employed. Ore is usually handled in standard railroad ore cars of 60- to 80-ton capacity and waste rock in side-dump cars of 20- to 30-cu.yd. capacity.

Open-pit mining under different conditions from the foregoing is excellently described by A. H. Hubbell[4] in several articles on phosphate mining in Florida and Tennessee, where practices were developed over a period of years. The full revolving dragline scraper is widely used for stripping and in some cases for mining the phosphate bed. Hydraulic methods are used for mining the phosphate bed, and pumps and pipe-line deliver the material to the dressing plant, which is usually close to the pit.

MINING METHODS—The most interesting papers about mining methods are two by Mark A. Smith[5], who is an advocate of increased mechanization in metal mining. His discussions concern "cave mining" and ways and means for minimizing development by substituting scraper and conveyor movement of ore for gravity transfers, in the usual system of inclined branching-transfers connecting with grizzly drifts. These modifications of block caving were presented in generalized form in the mining review for 1939. In his second paper, Smith describes in detail scraper practice as applied at the Consolidated Coppermines property in Kimberly, Nev., to block-caving areas. Improvements of orthodox methods are to be expected by such efforts as well as from studies of other mechanical operations, such as coal mining.

The application of diamond drilling for blast holes as exemplified by Noranda's sublevel stoping has been extended at other properties, with Mt. Isa using similar methods. Diamond-drill blast holes are being used at the Walker mine, in California, and at Dome for special conditions. V. Cortlett and G. D. McLeod[6] describe the use of diamond drilling in open stopes at the Aldemac mine, in Canada. Floor pillars and backs are broken by blasting groups of diamond-drill holes. Some groups are fanned out at various angles from drifts; some were drilled vertically and spaced parallel from a vertical slot with horizontal holes drilled in stope backs from end slots. The authors give cost and performance figures of value. Diamond-drill holes were of $1\frac{1}{16}$ in. in diameter and were drilled by hand-set inwardly-coned bits without coring. Dynamite cartridges are $1\frac{1}{4}$ in. diameter and Primacord is used for detonation of charges. Satisfactory fragmentation is obtained by simultaneous blasting of groups of holes. The authors conclude that the use of the diamond drill in large open stopes is sound practice, is simple and safe, and eliminates a large amount of development work.

SHAFT SINKING—Shaft sinking in quicksand is described by E. S. Tillinghast[7]. No new features of the drop shaft method are given, but operations are so clearly detailed as to be helpful to operator and engineer.

TUNNELING — Descriptions[8] of two important mine tunneling operations have appeared in various publications. Both tunnels, the Elton (Tooele County, Utah) and the Carlton (Cripple Creek district, Colo.), are approaching completion. The former is to be 24,000 ft. and the latter over 30,000 ft. in length. At the Elton tunnel some 8,472 ft. were driven in alluvial material which necessitated heavy timbering and coping with large flows of water. The Carlton tunnel is in hard rock with small amounts of water and incidental timbering. Both projects are characterized by experienced operating organizations, well selected equipment, and high rates of driving.

The excavated sections of both tunnels are about 11 ft. in height by 10 ft. in width. Grades are 0.35 percent in the Elton and 0.30 percent in the Carlton. In the Elton a concrete-lined water ditch is carried on one side of the section and in the Carlton temporary drain ditches are made on either side of the haulage track. Single track, of 45-lb. rail on 24-in. gage, is used in both places. In both operations "jumbos" are used for supporting the battery of five drills. At the Elton, automatic-feed drills are in use, at the Carlton motor-feed with steel centralizers on front end. Replaceable bits are standard at both tunnels. Starting bits are $2\frac{1}{4}$ in. in diameter with holes to about 9 ft. in maximum depth. At the Elton a 34-hole round, 9-ft. in depth, was used and at the Carlton 32- to 38-hole rounds 8.5 to 9 ft. in depth, using electrical blasting and 40 per cent explosive in both cases. Mucking machines are used in both tunnels.

The Elton employs 50 cu.ft. Coeur d'Alene side-dump cars in trains of 20; the Carlton 3-cu.yd. Granby-type cars in 14- to 17-car trains. The Elton locomotive is battery-trolley type, 10-tons; the Carlton is an 8-ton storage-

battery type. Both tunnels employ exhaust ventilation with booster fans and steel ventilating pipe. At the Elton 22-in. diameter and 18-in. diameter at the Carlton.

Progress at the Elton averaged 24 ft. per day, maximum 46 ft. and best month 982 ft. The Carlton established noteworthy records, with the best month in March, 1940, when 1,735 ft. was completed. The maximum daily was 74 ft., minimum daily 26 ft.; number of rounds per day 6.5 to 7.2; average drilling time per foot 12.5 to 18.6 min.; average mucking time per foot 11.1 to 18.4 min.; explosives per cubic yard solid 5.1 to 10.4 lb.

Large sections, deep rounds, semi-automatic drills, detachable bits, jumbo carriage, mucking machines, storage-battery locomotives, dependable explosives, adequate ventilation and lighting, plus experienced crews and foremen represent mining progress and make such records possible.

DIAMOND DRILLING—At least four new diamond drills are available. They are all aimed at the one-man drill objective which may soon be attained if it has not already been reached. Light-weight, dependable drills with high-speed characteristics constitute a difficult problem for designers, and demands of underground service are exacting. Longyear, Sullivan, and Boyle Bros. have light drills on the market; the Longyear drill weighs 160 lb.; the Sullivan drilling head weighs 127 lb., and its detachable air motor 80 lb., a total of 207 lb. Boyle Bros. drill weights 75 lb. with rod hoist and 130 lb. without hoist. The Longyear utilizes a vane motor, Sullivan an air motor, and Boyle Bros. a single-cylinder air engine. All have variable feed screws and throttle control. Another drill designed by J. L. Havlick departs from the "classical" diamond-drill mechanism by throwing out all gears and feed screws of the differential type. It consists of a hollow drill stem, driven by a vane motor of 5, 8, or 15 hp., with a swivel hose connection at one end and drill-rod connections at the other. This is mounted on a feed-screw and V-shaped shell that can be carried on tripod or column. The weight of the drill is said to be 110 lb. Trottle control and hand feed, quick set-up, and ease of shifting characterize the Havlick drill, which is being used for grout holes 30 ft. in depth.

High speeds continue to be employed and with varying success. Maximum r.p.m. of 2,500 to 3,000 are common, but throttle control can quickly reduce these speeds to meet the drilling conditions, and some operators get better results at lower speeds. One contractor stated there is a definite trend toward larger-diameter holes, as 75 percent of his core work is now 1⅛-in. diameter instead of $1\frac{1}{16}$ in.

An account of diamond-bit development would take many pages, but four types are conspicuous. They are the soft-steel hand-set bit; the processed bit (Rowland) in which powdered metal pressure and heat form the diamond-studded matrix on a soft steel blank; a steel bit in which cast inserts carrying the diamonds are brazed (Koebelite bit) and the diamond impregnated Carboalloy crown brazed onto a steel blank. All use bortz grade diamonds. The end cutting surfaces are rounded rather than flat-faced. Two kinds are made, the coring type and the full-hole bit, usually with a concavity at the end rather than flat. Some mining companies buy manufactured bits and others employ setters to prepare their own bits.

Experimentation continues, but conclusive results are elusive, as variables are numerous. Probably the most significant investigations are reported by D. A. P. Wilson[9], who systematically prepared diamond-impregnated bits with various matrixes and tried them out under controlled conditions. The matrix metals comprised 3 percent carbon white iron, iron, and molybdenum as one combination; ferrochrome plus iron, chromium, and cobalt; 3 percent carbon white iron, plus iron as a friable sinter; 3 percent carbon white iron and iron alloyed. The bits were made by powdered metals mixed with crushed and sized diamond particles placed under pressure and heated electrically. The weight of diamonds in each bit was 7.5 carats and the degree of impregnation was 40 percent by volume. Wilson found that, by using 2,900 r.p.m. and 600 lb. load on a drill 0.62 sq.in. in cutting section, penetration speeds of 8 to 15 in. per minute were obtained, depending on the kind of rock attacked. With the same drill and speed, loaded to 480-lb. pressure, the penetration was reduced from zero to 3 in. per minute. Thus he established a critical bearing pressure for a given rock and speed of rotation.

W. C. Weslow[10] presented a paper detailing laboratory and field operation of diamond-impregnated bits in which tungsten carbide and cobalt formed the matrix. It was found necessary to use a sand-blast resharpening process to clear away the matrix from the diamond cutting points.

W. Roy Dunbar describes diamond drilling at the Hollinger mine[11], where it is used principally for exploration. A. V. Corlett and G. D. McLeod[12] describe experience with diamond drill blast holes at the Aldermac mine, in Canada. Bits were hand-set. Average costs per blast, including labor, explosives, diamond loss, setting, and supervision, were 11.54c. per ton broken. From other examples tons broken per foot of hole ranged from 0.7 to 3.6. Footage per bit ranged from 77.6 to 87.09; footage per machine drill shift ranged from 41 to 49. Direct costs per ton broken ranged from 17.1c. to 92c.; bit-setting costs per foot varied from 24.1c. to 28.5c.; drilling cost per foot ranged from 23.1c. to 26.8c.; total drilling cost ranged from 47.7 to 52.8c. per foot.

MISCELLANEOUS—Ground Support: Most significant are the studies being made by P. B. Bucky[13] and his associates on photoelasticity in application to mine pillars, mine supports, and other features of the physics of rock masses and the internal distribution of resisting forces set up in various types of supporting structures. There is a rich field in mining for research on mine supports and the possibilities of improved designs and applications.

E. A. H. Joseph[14] extended his discussion of "crush bursts" by answering his various critics. He proposed a method for relieving expansion and creep in footwalls and hanging walls, where mass movement begins or is expected in deep mining, by narrow cuts at intervals normal to the strike, thus giving room for expansion before walls bulge and burst and also utilizing the excavated material in part for filling contiguous stope areas.

Ventilation: The air-conditioning plant installed at the Ooregum mine, in the Kolar district[15], is described by J. Spalding and T. W. Parker. Thus another deep mine has had to resort to air conditioning. The refrigeration plant in this instance is on the principle of the dry compression cycle using ammonia as the refrigerant and brine as the secondary medium of heat transfer. The first unit was installed at this mine in August, 1938 and the second in April, 1939. The bottom level of the mine is 8,330 ft. below surface, with initial rock temperatures of 134 deg. F.

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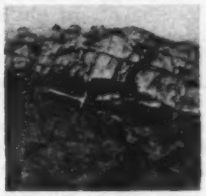
Mining Geology

In a round-up of current theories of ore deposition and their application to mining, the author suggests reconsideration of all hypotheses. Geological research should be encouraged.



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THE END OF 1940 marks the end of a decade as well as a year. It seems an appropriate time for an appraisal of mining geology. It may coincide with a minor lull in a cycle of publication much as did the 1929 era. Many geologists apparently do not find time to write up their observations in the boom years. One recalls the flood of publications during the 1930-38 depression.

There was a feeling of futility in much of the application of mining geology in the early 1920s and empiricism in much of the research. At that time one could usually baffle a geologist with the question "Do you know of a mine or even an orebody found by geological method?" But it was during this period that economic geology became startlingly effective in exploration for petroleum. Studies of structure were responsible for most of this success, and not many years later the more careful study of and emphasis on the structure in mines and mining districts gave good results in the search for metallic and non-metallic mineral deposits. The last part of the last decade has seen some of the partly well justified opposition to geological work in mines disappear. The well informed can now give many examples of orebodies discovered, mines found, and mines revived by geological work. In the last half of 1940 the demand for well-trained and experienced mining geologists resulted in a shortage of such men.

The science of mining geology, like most others, can be divided into two distinct divisions: one the field of pure theory and the other the field of the application of this theory. In chemistry and physics, for example, well-founded theory is often well in advance of the application of it, but in mining geology the application of simple, direct, usually empirical concepts only has resulted in success. The broader theoretical framework is in dispute at many points and, as might be anticipated, the application of it usually results in failure.

The divisions of study which experience has shown aid in ore finding include, first, detailed surface and underground mapping, usually on relatively large scales but which are fitted to the conditions. This mapping pays most attention to lithology, structural forms, topography, and alteration. Second, integration of the map data into three-dimensional pictures by the use of horizontal and vertical sections, projections, contour maps, models, etc., and, third, formal study of details of lithology, structure, topography, alteration, paragenesis, oxidation and gossans, enrichment, form and character of oreshoots, and a few other special studies which may be appropriate for the particular deposit. We know a good deal about the environments of orebodies, and this knowledge is of great value. To date, however, theoretical considerations such as ideal hypogene zoning in depth, origin of fluids, character of fluids, differentiation, etc., have not been of much help. The theory of the association of particular metals with particular types of igneous rocks has been useful especially in the search for platinum metals and chromite, although Wagner in an editorial titled "The Danger of Generalizations"[1] tells of platinum in a quartz lode in felsite in the Waterberg district of the Transvaal. Paleontologic research has been critical in the discovery of old beach placer diamond deposits and Augustus Locke says that the discovery of the deep coal seams in Belgium was a byproduct of pure research in geology. As is well known, also, the potash deposits in southeastern New Mexico were found by the United States Geological Survey by pure research.

For the appraisal of the field of theory it is convenient to divide the various subjects under three headings: (I) parts of the theory now generally accepted and established, (II) parts which are controversial, and (III) parts advocated as hypothesis by only a few. These items are listed with the belief that they are not segregated by personal bias.

I—Parts of the Theory of Ore Deposits Which Appear to Be Firmly Established and Now Seldom Subject to Dispute or Modification

1. The metals of the ores are in most cases epigenetic and have traveled distances from a source measured in thousands of feet, if not in miles.

2. The path traveled by the metals and other elements is usually well defined and is a fracture, fault, or other opening which ultimately cuts downward at a relatively steep angle.

3. The metallic ores are usually associated with features of vulcanism such as intrusives, extrusives, volcanoes, calderas, breccia pipes, hot-spring activity, etc.

4. The ore districts are usually found in important belts of orogenic disturbance, often in or near belts of overthrusting.

5. Orebodies are usually found in special structural invironments such as fissure intersections, fissure junctions, changes in the dip and strike of a vein, contacts, etc. In general ore favors channels or loci of maximum breaking and brecciation.

6. Ore deposition tends to form approximately vertical tabular elongated zones or orebodies in schistose basement or isotropic igneous rocks, and bedded zones or orebodies in bedded horizontal rocks.

7. Nearly horizontal shales and sills often cap horizontal orebodies as though they acted as barriers to upward movement.

8. Orebodies do not stand by themselves without "roots" below and "leaks" above; that is, inlets and outlets.

9. Horizontal zoning often forms a definite pattern but does not always follow a "standard" sequence.

10. The association of particular metals with particular igneous rocks results in useful generalizations such as the usual association of chromium and platinum with basic rocks, gold with sodic rocks, most metals with rocks of intermediate composition.

11. Limestone and dolomite are the best hosts for ore in many districts.

[1] Wagner, P. A.: "The Danger of Generalizations." *Ec. Geol.*, Vol. 20, p. 283, 1925.

12. Wall-rock alteration is usually in proportion to the intensity of the metallization. This is one of the most valuable of the generalizations which can be used in the appraisal of prospects and in exploration.

13. The bulk of quartz and silicates are nearly always older than associated sulphides and gold.

14. Many reopenings (rebrecciations or breakings) are characteristic of most ore deposits.

15. Most ore deposits can be proved to be later than associated intrusives. They are usually found to be later than associated pegmatites.

16. High temperatures tie up quartz and other elements as silicates. Lower temperatures permit quartz, iron, lime, etc., to deposit in simpler forms.

17. The chemistry of supergene copper enrichment appears to be well established.

18. Many mercury, some manganese, and a few other metallic deposits originate from hot-spring activity.

II—Parts of the Theory of Ore Deposits Which Are Still Controversial

1. Ultimate source of ores.

2. Chemical character and physical state of the fluids which brought in ores.

3. That part of the theory of differentiation of igneous rocks which postulates the origin of ore through differentiation.

4. The validity of a standard type of vertical zoning except for a given district.

5. The validity and therefore the usefulness in the field of our present classifications of ore deposits and present ideas of persistence in depth for given "classes" of ore deposits, epithermal deposits, for example.

III—Relatively Unorthodox Views Advocated by a Few

1. Most ores are intruded in an essentially magma-like state.

2. Ore can be concentrated by the activity of meteoric waters—that is, by lateral secretion.

3. Meteoric waters are an important factor in the deposition of the ores through cooling effect, absorption of ore fluids, etc.

4. The almost universally characteristic gangue mineral of ore deposits, quartz, can be derived from the alteration of silicate bearing wall rocks.

5. Ore fluids are often acid in character.

The striking generalization which can be made is that we have no proved framework of theory on genesis. The tested ideas which are successful in ore finding are largely such empirical tools as measurements of the structure and composition and physical character of rocks and ores, though it includes some minor but well-established chemical theory such as that of the supergene enrichment of copper.

The widely supported hypothesis for the genesis of the metallic ores postulates an origin from hot intrusive magmas that as they cool "differentiate" heavy and light fractions. The light fractions are characterized by an abundance of water, quartz, and alkali sulphides and are related to, but normally deposited farther away from, the intrusive than the pegmatites. The heavy fractions include differentiates of metals such as iron, nickel, copper, chromium and platinum, which may be separated by immiscibility or crystal settling and deposited within the intrusive itself as syngenetic bodies of oxides as well as sulphides. This hypothesis perhaps reached its widest credibility about two decades ago when few if any of its premises such as the intrusive nature of all the plutons, all the pegmatites and aplites, and the syngenetic character of all the "magmatically differentiated" ores had been seriously challenged. A disturbing note had been sounded by the French school not long before, which suggested that some plutons were metasomatic in nature, but the idea became a mere whisper by the time it reached the United States.

The magmatic theory may have reached its high-water mark in 1923 with the publication of an essay by an American author which postulated that veins were merely an extreme form of igneous rock and were intrusive. Few of even the most ardent supporters of the theory would go this far. About that time and from then on many data were put forward which had more timely significance than perhaps was or is appreciated. Members of the geophysical laboratory at Washington published a number of papers, partly in relatively inaccessible mediums, on volcanism, volcanic exhalations, and hot springs, which among other things emphasized the importance of gases as agents for the transport of metals. Certain students of pegmatites made a strong case for the formation of some pegmatites by metasomatism, many plutons formerly defined as intrusives in the United States and Canada were ascribed to metasomatism—that is, granitization.

Most students acknowledged that ore deposits appear to be later than adjacent "intrusives" and associated pegmatites and some so-called magmatic differentiates were described as epigenetic. An authoritative British writer gave evidence that the lead of ore deposits was likely to be different from the lead common to granite. Several authors advocated the derivation of vein quartz by wall-rock alteration and then as a climactic idea evidence was published that ore deposits in the Cornucopia district of Oregon were deposited by fluids which were a later extension of the fluids which made the associated "intrusive" rock by metasomatism.

Just when it appeared that the part of the geological fraternity which had inherited the duty of developing the theory of ore deposition had, so to speak, settled back with, shall we say, self-satisfaction and the belief that a rational, well-supported explanation for the genesis of ore deposits had been developed, a number of ideas almost puckish in their timing were advanced that if substantiated had the power of undermining the entire previous structure. An eastern school of geologists seems to have sensed early the possibilities for damage to the magmatic theory by some of the recent data outlined in the foregoing, and to have almost self-consciously set about, by many words and an almost after-thought type of appendix to various articles published by the younger students, to support the theory in essentially its classic form. Many of the significant data, difficult to combat, were, however, largely ignored. The tactics have been those of defense. There have been no fundamentally new data brought forward to support the theory for several decades, so far as I know.

It may be nearly impossible for an individual to appraise any one possible hypothesis of ore deposition without having some bias, because of the great variation of experience as between geologists. But my protest is not so much against current fashion in theory as against what seems to be excessive dogmatism and the shutting out of alternative hypotheses. The almost naïve faith of many in the magmatic "theory" is difficult to understand when it is apparent that many of the facts of occurrence, which indeed may be keystones, can be explained by more than one genetic process. Possibly we have unconsciously rated this "theory" on a level with modern chemical and physical theory because it was developed along with these sciences to a nearly contemporaneous peak in the 1920s. But perhaps we forget that the theory of these sciences was susceptible of experimental proof step by step, whereas ore genesis theory to date has not been supported in any even remotely convincing way by experiment. We may in time be able to devise and build apparatus which will duplicate the conditions in depth and deposit orebodies on a small scale similar to those made millions of years ago, but first we must know what the conditions were, and one wonders if we shall soon know that separated from a fatal burden of doubt. Possibly we shall

discover these conditions by trial and error.

Considering all these things, should we not admit more ignorance of the elements of ore deposition theory than is popular and reconsider all possible hypotheses? Our knowledge today seems to limit these to the following:

1. The lateral secretion hypothesis which essentially postulates that metals are gathered and concentrated by meteoric water.

2. A justifiable modification of (1) postulates that the gathering medium is fluid of "igneous" origin.

3. The hypothesis which postulates the emplacement of orebodies by intrusion—that is, the "ore-magma" hypothesis.

4. The magmatic differentiation hypothesis.

5. The hypothesis that postulates the origin of both intrusives and ore deposits through the agency of fluids and heat of sub-crustal origin.

It would be difficult to deny that at some time or place a metalliferous deposit could not have been by any one of the five processes postulated in the foregoing. But the many features which, let us say, the majority of ore deposits have in common suggests a similar mode of origin for most of them.

The lateral secretion by meteoric waters hypothesis has not been in very good standing for some time, largely because the Mississippi type of lead-zinc ore deposits in limestone, by many lines of evidence recently reviewed in the literature, seem to be of "igneous" origin. But there is no inductive evidence of origin from the differentiation of igneous rocks, though the several supporters of the "igneous" theory seem to believe that once an "igneous" origin is a reasonable explanation a differentiation origin also is implied. Such deductive reasoning does not seem fair minded at a time when the magmatic theory itself is being self-consciously and voluntarily defended by the most active and voluble of its supporters.

So far as meteoric waters go, it still seems possible for ore deposits to result by lateral secretion under special circumstances, particularly if the chemical activity of the solutions is accelerated by heating either by deep subsurface penetration or by the influence of hot igneous rock. Surely we must grant solution of elements from the walls along hot-spring channels, and the geophysical laboratory has demonstrated satisfactorily enough that the discharge is largely of meteoric origin. Many rocks contain appreciable quantities of disseminated metals, and it seems almost as reasonable to suppose these may be collected by circulating hot water as by differentiation processes. The problem of deposition is not critical in any of the hypotheses. Here, fortunately, we have much accurate knowledge and many reasonable processes.

"Igneous" fluids might well be more effective collectors than those of meteoric origin because of the greater possibilities for elevated temperature and active chemical solvents. Thus, if hypothesis (1) can still be entertained as a possible explanation for at least a few ore deposits, hypothesis (2) should have a still better standing.

Hypothesis (3) seems the least credible of all as a universal explanation of genesis. The many objections to it include: (1) the so-called suspended fragments are either explained as being only apparently suspended or, what I think is the true explanation for the more isolated ones, they were originally held in place by finely comminuated material including gouge. This material is more reactive than the larger fragments and is replaced by ore. In my experience this explanation for suspended fragments is the most obvious and can be proved in some cases. (2) Ores vary too much in grade and character from place to place in an orebody to have been in a magmatic state when intruded.

Hypothesis (4) has been discussed to some extent in earlier paragraphs. At the height of its credibility, say in the early 1920s, it was surely the most reasonable explanation offered. The differentiation of igneous rocks was well demonstrated, though the processes were debatable and the association of igneous rocks and ore deposits was established as a fact. Apparently well-supported examples of magmatically differentiated ore syngenetic with the inclosing rocks were described. The veins had been noted to contain a few minerals, particularly quartz, common to igneous rocks and the pegmatites seemed to be an obvious linkage. Further support for the linking was the apparent trend of differentiation toward the acidic pole. These data could result in only one logical inference as to the origin of metalliferous deposits.

In a very few years, however, new facts and alternative inferences accumulated. Many of the so-called syngenetic magmatic differentiates in view of additional observations were more logically explained as epigenetic deposits. It was found that most ore deposits were later than the associated plutons and often cut them. The chief function of the associated intrusive often appeared to be structural. In other cases the structures which localized the ores also seemed to localize the intrusives. The most damaging evidence of all was that some intrusives are replacements of the country rock, as proved by relict or ghost bedding and schistosity found far within intrusive masses and having orientations corresponding with the planar elements in the walls. It is easily proved, of course, that some "intrusives" are intrusive. Less disturbing perhaps was the realization that pegmatites are not the home of common metals, are usually proved older than associated ore deposits, and that no or few veins or ore deposits grade into pegmatites. As mentioned before, one author believed that ore lead was different from granite lead and another concluded after an apparently careful study of a district in Oregon that the ore deposits originated from fluids which were a later extension of those which made the inclosing intrusive by metasomatism.

So we come to the end of 1940 with hypothesis (4) still in almost exclusive favor, particularly with the conservative thought in economic geology. I propose that hypothesis (4) is only justifiable as a hypothesis and is not nearly well enough organized and supported to be called a theory. Hypothesis (5) deserves consideration and even hypotheses (1) and (2) cannot be disregarded entirely as possible explanations for a few ore deposits.

A portable 6-volt ultra-violet black light offers the geologist and mining engineer opportunity for refinement in examining mineral deposits that may contain scheelite or minerals that fluoresce under short ultra-violet wave lengths

Mineral Dressing

Improvements recorded in 1940 for all fields of mineral dressing. Further momentum in unit-process point of view. Better equipment design is evidenced

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HEALTHY GROWTH has characterized the past year in nearly all fields of mineral dressing. Perhaps the most striking general improvements of the art are to be found in heavy-fluid processes and in the application of flotation to non-sulphides. In addition, an important change that has been in progress for several years has gained momentum; that is, the acquisition of the unit-process point of view. This development is fundamental and is bound to have far-reaching consequences in that it brings together, around any unit process, men of such diverse viewpoints as the coal miner, the cement maker, the ceramist, the industrial chemist, and the metallurgist.

The unit-process point of view is exemplified by considering the chief unit processes for the separation of solid particles from fluids: gravity settling, flocculation, centrifugal settling, filtration, drying. In years past problems using these unit processes in coal preparation, ore dressing, sanitation, air-conditioning, mining, cement grinding, and combustion—to name but a few specific industries—have been met by specialists in these various fields. In general, these specialists have shown little interest for work currently done in fields other than their own, yet dealing with the same unit processes. Happily, the trend toward the unit-process point of view is gaining, and it is becoming more widely accepted that the job of the mineral dresser is first to understand and develop the unit processes as such, and then to adapt them to a particular job.

Partly as a result of acquisition of the unit-process point of view, the field of work of mineral dressing is broadening. We are indebted to Professor Taggart for a most significant contribution to this development in a recent paper describing the new mineral dressing curriculum at Columbia University. He includes within mineral dressing any process that is used for the improvement, physical or chemical, of any mineral raw material—solid, liquid, or gaseous. However, logic has yet to vanquish tradition; hence, mineral dressing is here regarded as limited to the treatment of solid raw materials that do not undergo bodily chemical change.

COMMINUTION—Improved design of gyratory crushers, cone crushers, and grinding mills is in evidence. Among the new machines are the Peacock crusher (a Canadian product) and the Traylor-Stearns Multistage fine-reduction crusher. Particular attention is paid to the removal of tramp iron, as for example in the hydraulic mechanism designed by Allis-Chalmers for the relief of the crusher heads of reduction gyratories. This mechanism also provides for quick adjustment of crusher setting and permits opening the crusher for clearing after a power shutdown.

Alloy steels and alloy cast irons with particular appropriate physical properties are frequently proving to be more than worth their higher initial cost as metals of construction for crusher plates, crusher shafts, roll shells, mill liners, grinding media, and other wearing and breaking parts.

More use is now being made of the fact that sizing analyses of comminution products tend to follow definite mathematical equations—and therefore can be plotted as straight lines when proper scales are chosen. Comparisons of size analyses are simplified, and useful means are afforded for quantifying the crushing characteristics of a particular material or of a particular crushing method. Other applications which might be mentioned are surface calculations, screen calibrations, and extrapolations of sizing data. Although the equations involved are empirical, their wide applicability suggests that a fundamental principle of comminution is involved. It is of interest to note that a new equation was offered practically simultaneously by A. O. Gates and by R. Schuhmann, Jr.

In view of the large proportion of the total cost of ore treatment that is represented by crushing and grinding, any marked improvement in the economy of comminution would be immediately reflected in large savings. Although comparisons of standard comminution devices with "frictionless" drop-weight and pendulum crushers on a Rittinger-law basis have indicated comparative efficiencies of the order of 10 to 50 percent in commercial comminution, present-day thought is that the true energy efficiency of comminution is much lower than these figures indicate. With the quieting of the Rittinger-Kick dispute and the acceptance in principle of the Rittinger theory, the stage seems to be set for a new phase of comminution research.

SIZING—The use of vibrating screens is being successfully extended at both ends of the size range. Wet screening at as fine as 65 mesh has been made practicable by the adoption of stainless-steel cloth. It is possible that future grinding practice may involve in some cases circuits closed by screens instead of mechanical classifiers.

Another interesting development is the Symons rod-deck screen, which is said to handle readily wet, sticky materials.

New developments in the field of classification have led to the commercial adoption of devices to make separations at sizes of the order of magnitude of three to five microns, equivalent to 3,000 to 5,000 mesh. A few years ago a separation of this kind was a delicate laboratory job. Now, this same separation is being made in practice, and perhaps more accurately than was possible in the laboratory before: where large volumes of suspension are treated at once, there are fewer difficulties due to temperature irregularities and the convection currents which they generate. Much of the credit for this industrial development goes to the staff of the Dorr Co. At the other extreme of the size range, the same company has introduced the Hiflow classifier which is suitable for sizing at as coarse a size as 3 to 5 mm. Thus, commercial devices are available for making sizing separations

by settling in water in a 1,000-fold size range, from a few microns to as many millimeters.

Closed-circuit grinding to micron sizes using Bird continuous centrifuges in circuit with ball mills is now practiced in a few plants for the grinding of industrial minerals. This development, together with the developments in classifiers mentioned in the foregoing, should facilitate expansion of ultra-fine grinding.

Just as commercial separations are now being made by settling in a range of sizes where research held forth a few years ago, so research has moved into a range of sizes that was beyond reach a few years ago. The trend in laboratory sizing in the range from one to fifty microns, using sedimentation methods, is now toward perfection and standardization of preferred techniques. The old reliable sedimentation-and-decantation method, the Cooke short-column hydraulic elutriator, and the Haultain Infra-Sizer are examples of well-standardized fractionation methods. For measuring size distribution, without fractionation, the Andreasen pipette method and the Casagrande hydrometer method are widely used with essentially standardized apparatus and procedure. All work of this type has benefited greatly by wider appreciation of the importance of *complete* dispersion and by the accumulation of more information as to dispersion methods and dispersion agents.

Notable advances in the sub-micron range of laboratory sizing include an adaptation of the hydrometer method to sedimentation in a centrifuge (F. H. Norton and S. Spiel) and also a new method of accurate fractionation using the Sharples Super-Centrifuge (E. A. Hauser and J. E. Lynn). The further development of accurate methods of sizing to 0.01 micron, which is now in progress, should be particularly helpful in the field of comminution research as a means of extending surface measurements and, of course, as a means of correlating properties of clays with those of ceramic ware.

A new method of determining specific surface by permeability measurements has been developed by P. C. Carman. The apparatus is simple and apparently gives reliable and reproducible results on powders whose average size is two microns or more.

GRAVITY CONCENTRATION—In the field of gravity concentration considerable interest is shown in the use of jigs to remove heavy mineral as soon as it is reasonably free, and also as an alternative to riffled launders. The jigs for these purposes are of modern designs which avoid the leak around the old-style plunger and permit the effective use of a higher frequency. For the sizing of coarse coal surprisingly low speeds have been suggested by recent work at the Battelle Memorial Institute.

From Bolivia report comes that increased use is made of flowing-film concentrators of the round-table type to improve the recovery of tin.

Use of shaking tables for the separation of agglomerated feeds is expanding while the use for treating plain feeds holds its own.

Interest in gravity concentration continues to center in the development of heavy-fluid processes for the treatment of both coal and metalliferous ores. For the treatment of coal, heavy-liquid processes are the recent novelty, as heavy-suspension processes have been known for many years since the introduction of the Chance process. The heavy-liquid processes are of two kinds: saline solutions and organic liquids. The saline processes have been developed largely in Europe, where their use was said to be extending when the war broke out. In this country the plant built by the du Pont Company for the cleaning of coal by a heavy organic liquid is being operated, and much interest will be evidenced when the detailed results are generally available. The process, it is hoped, will be developed to the point where it can treat fine coal as well as coarse; only then will it gain the wide field which its originality merits.

The heavy-suspension processes for the treatment of metalliferous ores must operate at specific gravities ranging between 2.6 and 2.75, or perhaps even higher. The number of solids available for the formation of the separating medium is limited, and as the suspensions are quite thick, their mechanical properties become of importance in determining what will happen (F. D. DeVaney and S. M. Shelton). Study in this field will probably be extended.

The important plants at present are the Mascot zinc mill of the American Zinc Co. at Mascot, Tenn.; the Central mill of the Eagle-Picher Mining & Smelting Co. at Picher, Okla., and the Harrison iron ore plant of Butler Brothers, on the Mesabi range, Minnesota. These plants are especially interesting in that they use different media and different methods of medium purification: at Mascot the galena medium is cleaned by gravity, at the Central mill the galena medium is cleaned by flotation, and at the Harrison plant the ferrosilicon medium is cleaned magnetically.

FLOTATION AND AGGLOMERATION—In the field of treatment of sulphide ores, recent developments include the availability of data on the molybdenite byproduct plant of the Utah Copper Co., and the design and operation of a plant for the treatment of sulphide and oxide tailings from the Ohio Copper Co.'s plant.

For gold-and-silver-ore treatment, flotation continues to be applied as an adjunct unit process to cyanidation or even as the sole concentrating process.

The more striking developments have been in the treatment of non-sulphides. Manganese ores head the list with the application of flotation to the carbonate ores of the Butte district and the oxide ores of Cuba. The Cuban operations have been described by F. S. Norcross, Jr. Flotation plants for the treatment of phosphate rock have grown in size and number, and the same is true of plants for the treatment of potash salts and of cement rock. Other applications include the separation of mica from kaolin, of fluorspar from carbonate, silicate and sulphide impurities, of feldspar from quartz and other silicates, of scheelite from siliceous and carbonate impurities. Laboratory experiments in the separation of nonmetallics have been extended to many other minerals and in fact to products of the chemical industry that are not mineral products.

As reagents, interest continues to center on the positive-ion agents, (cationic agents). Little is known concerning them in a fundamental way and they have not yet been made available in sufficient quantity. Profitable fundamental research work can be done in this field.

Flotation machines continue to be improved in a mechanical way. The Fagergren machine, the Agitair machine, and the deep-cell pneumatic machines of the Britannia types are the designs that have aroused the most interest.

In the field of fundamental flotation study there have appeared some interesting articles by I. W. Wark and K. L. Sutherland, by S. F. Ravitz, E. H. Rose, O. C. Ralston, and others.

MISCELLANEOUS PROCESSES—The use of wet magnetic separators continues to expand. A large plant in Japan employing fifty-two machines is reported. Another interesting development is the use of wet magnetic separators employing kerosene in place of water. Magnetic separators are now used not only to purify iron ores or to remove iron minerals from silicate raw materials, but also to purify heavy-density, ferrosilicon suspensions.

A renewal of interest in electrostatic separation has been noted with application of the process to recleaning phosphate flotation concentrate in Florida. A shaking table using electrostatic separation is being used in an experimental way at the United States Bureau Mines' research laboratory at College Park, Maryland;

(*Continued on page* 135)

Iron-Ore Beneficiation

Lower-cost mining makes lower-grade ores available for economic treatment. Keeping pace with mining, beneficiation of iron ore at lower cost, and higher recoveries, are forecast

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HEAVY DEMANDS were made on iron-ore production from the Lake Superior district during the 1940 season, and, as has been the custom for some years, beneficiation helped to supply a considerable proportion of the ore shipped to the blast furnaces. While the emphasis has doubtless been on production, the search for new or improved methods of concentration was not put aside.

In the western part of the Mesabi, a new jigging plant was put in operation. This plant contains six four-cell Conset pneumatic jigs, and was operated in conjunction with the straight-washing plant. Feed to the jigging plant was unsized, washed crude ore, crushed to pass ½-in. square mesh. In the straight-wash plant, the leaner fines are removed as tailings. The jig unit produced concentrates, middlings, coarse tailings, and fine tailings. Middlings were sent to a ball mill, and the ground product, deslimed in a rake classifier, was returned to the jigs. The production and re-treatment of middlings marks an advance in jigging practice on the Mesabi, where the general practice has been to make two products only—namely, concentrates and tailings. Fine jig tailings, leaving the jigs with the overflow, were sent to a hydroseparator, the underflow from which went to a rake classifier and returned with the jig feed. This attempt to recover more of the fine-ore particles likewise constitutes an additional step in the direction of more complete utilization of the crude ore coming to the concentrating plant.

Another plant in the western Mesabi district, using the heavy medium, ferrosilicon process, completed its second season of successful operation. A large tonnage of crude ore, as well as jig tailings made in previous years, was treated, and there were few delays in operation. As has already been recorded, the process is applied at present to plus-¼-in. material, and the ore finer than ¼ in. is treated in jigs. Experimental work is continuing with the object of extending the use of the ferrosilicon process to finer sizes. There is little doubt that material as fine as 6 or 8 mesh can be handled, but application of the process to finer sizes presents problems which appear difficult of solution. A smaller plant, using the same process, was put in operation on the Cuyuna range, where manganiferous iron ore was treated.

In an effort to find a more efficient means of treating minus ¼-in. fines alone, a 6-ft. diameter, pilot Hydrotator was operated in one of the plants on the Mesabi, for some time. The middling products made by it were screened at 28 mesh, and the undersize was returned to the machine with the object of increasing the density of the separating zone. Various changes were made, all with the same purpose of building up a heavier separating medium. The Hydrotator has been successful in coal washing, and the work mentioned represents an effort to adapt the machine to iron ore.

Early in the history of concentration on the Mesabi, tables were used in conjunction with turbo washers for treating the finer ores. Both machines were displaced by the bowl classifier, though in Michigan the table was successfully used in some of the plants. In 1930, a table was built on the Cuyuna range, but was also replaced, this time by jigs. Some tables were installed in a Cuyuna plant in 1937, but again were replaced by jigs. In 1940, a table plant was placed in operation at the Spaulding mine, in the Birmingham district. The ore is

Operators on the Mesabi range are preparing for a record 1941 season

oolitic, having nuclei of gangue, and requires a scuffing grind to free the shell of ore from the silica core. Definite information is lacking, but apparently the tables are used for separating the coarser, scuffer ore particles from the gangue. If the operation is successful, it may again turn the attention of engineers in iron districts to tables as an additional tool for the treatment of fines.

In a concentrating plant on the Mesabi, four Akins classifiers were installed to replace two bowl classifiers. The operators claim to have achieved lower costs and improved metallurgical results through the change, and plan to place two more Akins classifiers in another plant. Another company, which is erecting a washing plant for a newly opened pit, proposes to use screens and Akins classifiers, thus eliminating log washers which have long been standard machines in straight-washing plants.

On the Vermilion range, the new concentrating plant at the Chandler mine is reported to have had a successful season in 1940. This plant is equipped with jigs, and treats ore from caved areas of the mine. Crude ore is obtained from both underground and open-pit operations. Some trouble was encountered in handling clayey material from the open pit, but this was overcome by increasing classifier capacity.

It is reported that a large company has begun to establish an experimental unit at its concentrating plant in the western Mesabi district. The unit will be equipped with pilot-size machines, and will contain the various types used in concentrating iron ore. The aim appears to be to survey the whole field of beneficiation of iron ore, with the object of determining on a pilot-mill scale the best flowsheets for the various ores in the company's mines. This will be the first test plant of pilot size to be built on the Mesabi. There are several laboratories where preliminary investigations are made to obtain indications for larger-scale tests. The latter are usually made at the Mines Experiment Station, at Minneapolis, where various flowsheets can be arranged on a pilot scale.

In conclusion, it may be said that the art of beneficiating iron ore is keeping pace with the parallel art of open-pit mining, in which transportation by truck and belt conveyors is becoming increasingly important. For ores that require beneficiation, these two major operations are essentially complementary. Changes in mining methods which result in lowered costs will tend to make available lower-grade ores that otherwise would not be amenable to economical concentration. Likewise, improved methods of beneficiation, resulting in lower costs and increased recovery, will also tend to widen the scope of mining operations to present marginal ores.

Copper Metallurgy

Capacity operation marks twelve months at most United States and Canadian smelters. Improvement of equipment with new construction reported at many plants. Foreign news scant

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OWING to increased demand for metal, most of the copper pyrometallurgical plants in the United States and Canada operated at full capacity during 1940. In general, operators concentrated on improving the equipment at hand, and in some cases bottlenecks were eliminated by installation of new equipment, both major and auxiliary. (The war makes it practically impossible to secure information regarding the plants in Europe.)

According to R. A. Wagstaff, the following problems are being studied at the various plants of the American Smelting & Refining Co.:

1. Improvement in gas firing on copper reverberatory furnaces. (a) Premix gas burners. (b) Forced draft gas burners. (c) Luminous gas flame. (d) Large and small unit multiple gas burners.

2. Water-jacketed side walls in the smelting zone of a copper reverberatory furnace. (a) Refractory-lined. (b) Cast iron. (c) Copper.

3. Uses of different types of refractories in both converter and reverberatory construction work.

4. Insulation of various types of furnace equipment. (a) Of settling zone of reverberatory furnace. (b) Of casting and anode furnaces. (c) Of roasters.

5. Use of spray gun in patching hot furnace arches and side walls with refractory material.

6. Judicious use of lime as a factor in saving metals and elimination of impurities from bullion.

7. Enlargement and refinement of waste-heat boiler installation on copper reverberatory furnaces. (a) Larger boiler settings. (b) Wider spacing between tubes. (c) Curtain walls, etc.

8. Increased size of roasters. (a) Larger diameter. (b) More hearths. (c) Larger motor drives. (d) Larger rabble blades.

9. Installation of dust and fume collectors of proper type throughout all plants. (a) Dust collectors in all crushing units. (b) Dustless connections at roasters and reverberatory furnaces. (c) Fume and smoke collectors on reverberatory matte taps. (d) Improved hoods on all converters.

10. Proper conditioning of all gases going to Cottrell plants. (a) Acid. (b) Water.

11. Control of sulphurous acid content in roaster gases by varying the degree of sulphur elimination.

12. Proper mixing and sizing of charges to be smelted in a reverberatory furnace.

A. E. Wiggin reports that the Anaconda Copper Mining Co. is building a new converter plant at Anaconda, Mont., in which will be used four 30x13 ft. Peirce-Smith converters and two tilting copper casting furnaces 27x13 ft., with a 40-ft. anode casting wheel. This will be built immediately adjoining the present reverberatory plant, so that matte from the reverberatories can be handled directly to the converters, and the converter slag can be handled directly back to the reverberatories without tramming. In the present plant the Great Falls vertical converter is used. The plant is some distance from the reverberatory plant, necessitating much tramming of hot matte and slag.

At the McGill smelter of Nevada Consolidated, according to Leonard Larson, increased tonnage demands during the latter part of the year necessitated operating an additional ball mill to furnish pulverized coal for the single reverberatory running. The second or auxiliary ball mill delivers a mixture of pulverized coal and air to two 12-in. burners, which enter the firing wall of the furnace about 30 in. above the regular burn-

ers. When operating with two ball mills, approximately 225 tons of pulverized coal are delivered to the furnace per day, the regular mill furnishing about 175 tons and the auxiliary mill about 50. With two ball mills and the double burner arrangement, about 75 percent of the total air required for combustion is delivered to the burners with the pulverized coal-air mixture.

The two upper burners are close to the furnace arch (about 32 in. below), which imposes extreme conditions of temperature and turbulence on the arch in the combustion zone. The increased smelting rate achieved, however, has far more than offset any injurious effects on furnace refractories.

During the period of general repairs early in the year, the front walls of the three waste-heat boilers which served the operating reverberatory were rebuilt with suspended refractory wall construction. The front wall of two of these boilers which are operated as a battery was supported by a single girder which extended to the two outside walls. The side walls of all three boilers were rebuilt with the suspended wall construction during the previous year. With this construction it has been possible to maintain better alignment of the boiler walls, install more working doors, and greatly minimize air infiltration. Under the extreme temperature and dust conditions encountered in the waste-heat boilers at McGill, the proper placement and increased number of doors have been of material help in keeping the boiler tubes and settings free of dust and accretions.

W. B. Boggs reports some interesting improvements that have been made at Noranda during the past year. In the reverberatory department a new 8 ft. by 60 in. Hardinge ball mill was installed for grinding coal to replace a Holbeck pulverizer. This was done for two reasons: (1) The Holbeck unit was badly overloaded and would produce only pulverized coal which was 70 percent minus 200 mesh, and (2) it became difficult to get spare parts. Consequently, the ball mill was installed, all spare parts for which can be bought in this country. This mill has increased the fineness of the coal from 70 percent minus 200 mesh to 92 percent minus 200 mesh and has decreased the coal consumption by about 5 tons per day; also it has reduced the maintenance costs of grinding.

Last spring there was installed for the two reverberatories a steam-driven centrifugal blower to supply secondary air for burning coal. The steam turbine which drives this centrifugal blower uses steam at 175 lb. and exhausts at 40 lb. for heating purposes. At the inlet end there are steam coils which heat the air to 100 deg. F. After the air is discharged it passes through a fin-type steam reheater operating at 175 lb. The resulting secondary air for burning coal enters the furnace at 310 deg. F. This has saved fuel, gives a steadier fire, has smoothed out smelting operations, and has made hot and cleaner reverberatory slags.

During November, the solid charge per furnace day in No. 1 furnace was 1,514 tons and in No. 2 furnace 1,511 tons, with fuel ratios of 10.5 percent and 10.4 percent, respectively. Recently in one day No. 1 furnace smelted 1,638 tons of solid charge and No. 2 furnace smelted 1,639 tons, with fuel ratios of 9.6 percent and 9.5 percent respectively. This fuel ratio is the tonnage of wet coal burned as received divided by the tons of dry solid charge.

No. 2 reverberatory has been running over two years without a shutdown to repair the suspended magnesite roof. As thin spots develop in the suspended roof, the bricks are replaced without cutting the fire.

In the converter department a new converter, 13 ft. in diameter by 28 ft. long, with riding rings at the ends, was installed. With the increased area of the air line, it is possible to use 25 percent more air than in the old shells. This shell also has a rectangular mouth of 57 sq.ft., an increase of 19.5 sq.ft. over the old 13 ft. by 30 ft. converters. This rectangular mouth has facilitated the operation of the converter aisle. The new converter makes a total of five, of which only four can be blown at a time. The idle converter can be used when one of the other shells is under repair and enables the reverberatory tonnage to be kept at a maximum during repair periods.

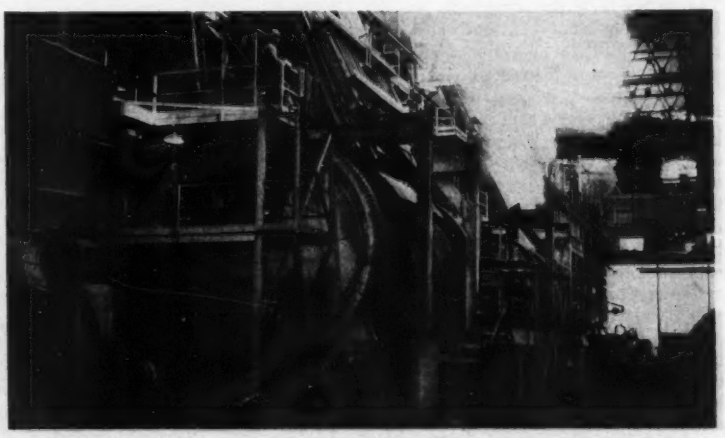
At the Flin Flon plant of the Hudson Bay Mining & Smelting Co., according to W. A. Green, a third converter was put into operation on Jan. 9. This is the only new piece of major equipment added during the year.

Four copper roasters are each handling an average of about 380 tons of feed per roaster day. The reverberatory, 22.6 ft. wide by 100 ft., is smelting close to an average of 1,400 tons of solid charge per day. The coal used has a heating value of 13,900 B.t.u.'s per pound of dry coal, and a fuel ratio of 9.12 percent is obtained, or 10.96 tons of solid charge smelted per ton of coal burned.

All the roaster Cottrell dust is now blown back to the next-to-bottom hearth of the roasters by means of venturis and pipes, similar to the scheme reported by Noranda (*E. & M. J.*, Feb., 1939), excepting that excess converter air at 15 lb. and 4 in. pipes are being used instead of 100-lb. air and 3 in. pipes. In addition, the outside of the roaster shells has been completely insulated to lessen the chance of shell corrosion. This is also expected to conserve heat in the roasters and to improve working conditions around the roasters in the summer.

At the smelter of the Andes Copper Mining Co. at Potrerillos, Chile, the consumption of silica brick in furnace arches and walls is reduced by spraying at intervals with a water slurry containing about 56 percent solids, made up of 97 percent pulverized silica and 3 percent fireclay. This is done while the furnace is in operation, and a protective coating of an inch or more is maintained on the surfaces exposed to corrosion, which lengthens the life of a furnace campaign to an indefinite extent.[1]

A special feature of the reverberatory furnaces used by Braden Copper Co. at Caletones, Chile, is a honeycombed roof produced by the use of slotted bricks, 20x6x3 in. The holes permit the heat to be distributed more evenly through the arch, thus reducing spalling of the roof and



Peirce-Smith converters measuring 13x30 ft. are employed by the Phelps Dodge Corporation at its United Verde Branch at Clarkdale, Arizona

increasing the life of the brick about three times. These furnaces produce a copper matte with 47 percent copper and 28 percent sulphur and a slag with 0.6 to 0.8 percent copper.

The Central Urals Copper Smelting Works, the largest of its kind in the U.S.S.R., situated in the heart of the Urals mining industry at Revda, 25 miles from Sverdlovsk, was recently put into operation.[2] Equipped in up-to-date manner, the plant occupies a place in the Soviet non-ferrous metal industry comparable to that of the Nagbitogorsk Works in the Soviet iron and steel industry. Its capacity is one and a half times greater than the entire output of copper in Russia in 1913. Copper ore will be supplied by the Degtyarsk pyrites deposits, which contain almost half the reserve credited to the Urals. Unlike other Soviet copper producers, this plant uses coal dust for firing the reverberatories, which is cheaper than oil.

A reverberatory in the plant, 105 ft. long and 26½ ft. wide, is one of the most improved type in the Soviet Union, and is the work of Soviet builders who took advantage of American and Soviet experience in this field. The charge of pyritic ore and flux is brought to the furnace by transporters and elevators, and the proportions are weighed and mixed automatically. Manual labor has been reduced to the point where the workers have to handle only the control and measuring devices, and the automatic scales.

The converters of this plant also are outstanding. They are the first in the Soviet Union to be provided with roller bearings, which make it easy to turn the entire unit. They also have an original automatic device for emergencies, a "charge ejector," for cases when the blast fails. The converters are charged by powerful overhead cranes able to lift a 75-ton load. From there the copper is poured into ingots, and after it has cooled off is mechanically loaded into railway wagons.

The Works has a well-organized concentrator, as well as a mechanical repair shop equipped for making not only spare parts but also entire machines. Two chimneys 394 ft. and 492 ft. high, carry away the sulphur-containing gases. These chimneys are situated some distance from the town, and a special pipe line carries the gases to them. The plant's equipment, it is claimed, makes it possible to extract 95 percent of the metal from the ore.

I desire to acknowledge the kind and generous cooperation on the part of the management of copper plants in the United States, Canada, and Mexico in preparing this review.

[1] Foreign Minerals Quarterly, Vol. 3, No. 2, April 1940 U.S.B.M.

[2] Metallurgia—Sept., 1940.

Lead Metallurgy

Smelter competition keen for ore supplies and concentrates. Capacity exceeds output during year. Attention directed to betterment of working conditions. Improvements in practice

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LEAD SMELTERS in 1940, in the less favored districts in particular, searched keenly for ore supplies. Zinc-plant residues have become of increasing importance as a part of the feed. Middlings and "scavenged" products from concentrators are being utilized where these have some value for their metals, as well as for fluxing. Leady flue dusts may comprise as much as a third of the smelter feed. Low-grade products from dumps and stope fillings have been shipped directly or reconcentrated. By coordinating the lead and copper smelters some remarkably low smelting rates have been given to shippers; owners of small and of low-grade deposits, by having a market for their products, have been encouraged thereby to try to develop new ore-bodies.

Where the lead, zinc, iron, and other minerals comprising an ore are not associated too intimately, concentrator operators are continuing to improve the grade of concentrates. The marketer of lead and also of zinc concentrates still finds it profitable to recover more of the lead, rather than to make the lead concentrate a few percent richer. In most smelters the percentage of coarse high-grade ore and of coarse gravity concentrates received by the smelters is decreasing, and the percentage of the total lead received as flotation concentrates is increasing. Roughly speaking, then, the lead in the feed to many smelters comprises rich flotation concentrates containing the bulk of the total lead received and many low-grade, often "scavenged," lead products from a multiplicity of sources. The competition for these lower-grade products is keen, particularly when they contain marginal precious metals, as well as for the products carrying more lead.

The larger tonnage now being handled by some lead smelter units makes it possible to smelt larger tonnages and lower-grade products. It is significant, however, that a mid-Western smelter with only barren siliceous feed found some years ago a cut-off point in lead content above which the lead concentrates were sent to Newnam hearths for direct metallization of the lead and below which the material went to the blast furnace via the Dwight-Lloyd.

That the capacity of American lead smelters is much greater than their present production is undoubtedly true. It is exceedingly inaccurate to compute their capacity in terms of present production per blast furnace, multiplied by the total number of blast furnaces in a given plant. The present capacity of the lead blast furnace has been reached by throwing more of the smelting load on other and often more costly units, such as the sintering machines, which have in turn thrown much more load on the flue systems. In general, with the technique developed to fit the materials now treated, any marked increase in capacity would first affect the sintering plant. Longer hours per week, and then larger sintering units, would be needed; larger gas- and dust-handling systems would be required.

Another general and decided trend in the United States was increasingly noticeable in 1940—that to improve working conditions in lead smelters. The increased volume of gases to be handled in better-ventilated plants, with the shorter hour week available for handling given quantities, accounts to a considerable extent for the load on many smelter flue systems. Among general ideas helpful in taking care of fumes have been the following: Metallic lead (whether as bullion or inclosed

as particles in hot sinter, etc.) should be kept out of contact with air. Hot lead sulphide, which has a higher vapor pressure than the oxide, should be similarly guarded. The use of reducing covers, inclosures to exclude air, and ventilating systems at exposed points has now become practically universal.

A smaller volume of air at a relatively high velocity, passing first across the workman's nose, then directly over the fuming substance, and thence to a small, properly designed flue, has been found to do much more good than a much larger volume of air subject to many vagaries in direction but passing in general at low velocity to some large overhead hood. To prevent mechanical dust the main idea is to ventilate in such a way as to prevent the countercurrent passage of dust and air in chutes, etc., when the dust can escape to the atmosphere, and to use water sprays and conveying systems designed to handle dust without leakage or mud if necessary. The Traylor, Redler, and other systems have been added to screw and belt conveyors.

Several smelters have conducted special campaigns to try to diminish the increasingly large volume of gas to be handled. Great air leakages in some instances have been found on systematically checking the source of all flue gases. To lessen leakage of air nearly all pallets now "slide across" instead of "roll across" the windboxes of the sintering machines. (The cooperative experimental work on making richer SO_2 gases (that is, using less air per unit of sulphur burned) on the Dwight-Lloyds at Trail noted in last year's review is still in the press.)

Special note has been made in other yearly reviews of the increase in size of various smelter units. The Bunker Hill & Sullivan has found that its large blast furnace, 66 by 252 in. at the tuyeres, smelts at about the same rate per square foot of tuyere area as does the 48 by 120-in. furnace. The larger furnace, however, gives steadier operation and less trouble from accretions, which improvements were thought to be due partly to increasing the elevation between the tuyeres and the slag tap by about 10 in. (There is no common agreement among the various smelters of the effect on the amount of lead in the slag of increasing the size of the bath of molten material below the tuyeres.)

Those forcing the capacity of the usual-size blast furnace to over 600 tons per day (with occasional days of well over 700 tons) are in general agreement that a single short jacket 6½ or 7 ft. high, with a brick top, makes for faster operation and easier barring. There is also a general agreement on using hot, circulating water in the furnace jackets; those using pumps to circulate usually keep the temperature from 140 to 165 deg. F. At Selby, where fresh water is costly, a thermal siphon is used, connecting from the top of the jackets to the side of a small overhead tank. Part of the return from the tank to the lower part of the jackets is cooled by sea water. A temperature of about 185 deg. F. is maintained. Some who force the capacity of the blast furnace less still prefer the double water jackets.

There is also general agreement among the operators of high-capacity blast furnaces on the helpfulness of a "predigested" sinter charge (that is, one thoroughly desulphurized, and prereduced with coke), a "high-lime" slag not too rich in silica, and the use of scrap iron in the blast furnace. Under these conditions there have been some marked changes in ideas on the amount of iron necessary to carry a given quantity of zinc in a slag and on the speed of smelting of zinciferous ores (2 Fe: 1 Zn was once thought about the right ratio). Now very fast running, "clean" blast-furnace slags are made containing, in percent, about: SiO_2 24, FeO plus MnO 37, CaO 18, ZnO 13, Al_2O_3 4, and Pb under 1. Those with highest blast-furnace capacities also attribute the most importance to using sized scrap iron and to feeding it regularly to the blast furnace.

In Bureau of Mines R. I. 3512 (May 1940) Messrs. Miller, Bainbridge, and Ellison give experimental evidence showing that at Trail control of blast-furnace operation by control of the pressure of the blast rather than its volume gives larger furnace capacity, less lead volatilized, more lead in the bullion, and less variation in furnace operating temperatures.

The American plants for volatilizing zinc (and lead) from lead blast-furnace slags continued to operate during 1940; most of the zinc in the slags, of course, came to the sinter plants as leached zinc residues. In some European plants the Waelz kiln has been used similarly to fume zinc and lead from many residual products besides blast-furnace slags, retort residues, dusts from roasters or returns from Waelz furnaces, and even zinc-leaching-plant residues themselves. (There is often more zinc to lead in the European products than in the American.) As a result, there have been insufficient outlets for lead, arsenic, and cadmium, which have accumulated in some parts of the Waelz circuits. During recent years, the Doerschel furnace has been developed to provide such an outlet. The Doerschel furnace is a short cylinder somewhat resembling the old Bruckner—it can be fired and gaseous products removed from either end. The lead-rich accumulations, well mixed with coke breeze, soda ash, and scrap iron, are fed in batches to this furnace, which does not revolve but oscillates slowly through a large angle. In this operation the cadmium is volatilized first and the richest portion caught separately; then a zinc oxide product is caught. The scrap iron forms speiss with the arsenic product and some matte. The metallic lead and residual slag are poured from the furnace.

Wider (63- vs. 42-in.) sintering machines (some 30 and more feet long) installed by the American Smelting & Refining Co., were found to operate satisfactorily throughout 1940 for both first- and second-over operations. The wider machines give a smaller proportion of "false air" down the sides of the pallets and therefore richer SO_2 gas. They cost less per ton of product handled to construct and to operate. With a 63-in. machine a standard feeder can still be used—a revolving circular table fed from a double-cone tank, provided with mixing rabbles for moisture and a discharge on the outside edge. A 63-in. windbox, as at present, is also not too wide to clean. The heavier pallets, however, are restrained from falling too hard or for too great a distance by special spring rails at the discharge end. The size of sintering equipment probably will be limited more by the size of available lead orebodies than by factors of machine design.

Perhaps the most obvious present general trend in sintering technique is the finer crushing of the first sinter. To take full advantage of better mixing equipment to get the uniformity of charge so essential to good sintering practice, an increasingly large number of plants use minus-⅜-in. feed to the final sintering machines.

There are still no very fixed rules as to equipment for handling smelter gases. Citations may be given of plants where Cottrells and where baghouses are used exclusively for all gases made, where blast furnace and sinter gases are mixed before removing dust, and where the gases are treated separately. Baghouses are preferred in many operations for neutral or only slightly acidic gases, such as those from the blast furnaces and at times from the "second-over" sintering machines. The Cottrell is still often preferred for the more highly acidic gases from the first-over Dwight-Lloyds. It is interesting to note that once either of the dust-collecting systems is installed, differences in costs of operation of the two are seldom great enough to justify a change. Scrubbers were installed at one plant for handling some mechanical dust. The "clearances" of dust, where true fumes are concerned, have not yet been made sufficiently high to cause the installation of any large mechanical dust collectors in lead smelters, where much fume must be caught.

BYPRODUCTS—The plants at Trail for treating smelter gases continued to fix SO_2 as sulphuric acid,

elemental sulphur, and fertilizers as ammonium sulphate. The experimental work at some American smelters has advanced in scale so that some tons of elemental sulphur of good grade have been made, and liquid SO_2 is available in larger quantities near a market.

The trend toward diminishing the load of drosses circulating between lead and copper plants has continued. Indications are that arsenic will be better removed "on both sides of the lead blast furnaces," that arsenic will be roasted from dusts fed to the sintering machines, and that arsenic will also be better removed from some matte-speiss products before they are sent to the copper plant.

Bunker Hill & Sullivan is now making star antimony of excellent grade in commercial quantities. Max Haberlein (*Trans.* Electrochem. Soc., Apr. 1940, Vol. 77, p. 119) gives a short summary of electrolytic lead refining in his review, with other notes of interest on the treatment of copper anode slimes where lead is present as an impurity, with other metals. The Cerro de Pasco company first detins its lead bullion, as tin is soluble in a fluosilicate electrolyte. The length of the corrosion period for anodes ranges from four days when less than 10 percent impurities is present, to one day with over 20 percent of impurities. Electrolytic solder is made at Carteret, N. J., by the U. S. Metals Refining Co. Impure lead-tin anodes are used in a fluosilicate electrolyte.

The present shipping situation and high freight rates brought about the use of a 50-ton and a 100-ton Mace furnace in the Philippines. (*E. & M. J.*, Aug. 1940, vol. 141, p. 77.) The former practice was to concentrate the precious metals into a copper matte for shipping. Now most of the precious metals are recovered from lead bullion as doré, and the remainder is shipped as a leady copper matte. It will be attempted to convert this matte and to ship copper only.

"Mineral Trade Notes" of the Bureau of Mines, with C. W. Wright's accounts in the January and July issues of the "Foreign Minerals Quarterly," give some interesting glimpses of the lead industry in other countries. National Lead Co.'s subsidiary at Puerto Vilelas, Argentina, made about 90 percent of Argentina's primary lead; it is estimated that in 1940 the production will rise above the 1939 figure of 14,150 metric tons. The concentrator recovers 88 percent of the lead as a 74 percent concentrate. The smelter has six Newnam mechanical Scotch hearths treating 25 tons per 24 hours. Fume made is 25 percent of the tonnage treated on the hearths. The gray slag, weighing 16 percent of the total feed and contain-

(*Continued on page* 89)

Zinc Metallurgy

War necessitated building new, and rehabilitating old, smelters in the United States to handle increased domestic production and large importation of concentrates

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WORLD zinc metallurgy, affected by wars and political changes, is in the midst of drastic readjustment. The Axis Powers have absorbed over three-fourths of the European zinc-reduction capacity but have not obtained control of corresponding sources of supply. The mines and smelters in the British Empire are working at capacity.

American stocks have dropped to low levels, with an indication of a shortage in the coming year. The bottle-neck in the industry is in smelting and electrolytic reduction facilities rather than in ore supply, owing to the large quantities of foreign concentrates available. Some zinc concentrates formerly treated in Europe are now being shipped to the United States, which permits full use of capacity at domestic smelters.

War has also affected the communication of news of foreign operations. The changes in source of supply have necessitated changes in the European zinc industry, but very little metallurgical information is available to show the degree and type of the changes made; the fact that Germany has acquired a large proportion of the European smelting capacity does not mean that Germany is in a position to produce metal in corresponding volume. Concentrates normally treated in western European countries originate in countries outside of the British sea blockade.

The domestic picture shows construction of new plant facilities and the repairing or replacement of old or obsolete plants to meet the rapidly increasing demands for zinc. The zinc industry is basically primary metal. Toward the end of 1940 smelter production was at the rate of nearly 790,000 tons per annum, of which 757,000 tons was at plants that treat mainly ore and 33,000 tons at secondary plants operating on zinc scrap. In addition, some 100,000 tons of zinc is recovered annually in secondary brass and used again in alloy form. Because scrap supplies are quite limited and cannot be increased to very large proportions, the bulk of domestic zinc will be obtained as primary metal from present electrothermic, electrolytic, and retort plants, all of which are operating near capacity.

According to George F. Weaton, of the St. Joseph Lead Co., the Josephtown, Pa., plant is being steadily improved and enlarged. A concrete shell and curtain Cottrell precipitator have been installed to collect fume from the sinter machine gases. Zinc and cadmium are removed from the collected fume by sulphuric acid leaching. The departure from conventional exposed-tube-type precipitators employed heretofore by zinc sinter plants was made to avoid condensation and corrosion problems. The sinter bed was increased from 10 to 12 in., with some increase in capacity.

A new metal furnace having an inside diameter of 96 in. was installed in the furnace plant in December. It is expected that the furnace, with its 28-ft. condenser, will produce more than 30 tons of zinc per day. The smaller furnaces (69 in. inside diameter) broke producing records in October, with an average daily production of 17.8 tons of slab zinc per furnace.

A two-year development program for mechanical working of the furnace-residue discharge tables was completed during 1940, with the installation of two power-driven poker buggies. They resemble, in motion linkage, the well-known St. Joe shovel used underground in Missouri.

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The zinc oxide department, from filter bags to finished pack, has now been mechanized by the installation of screen conveyors and bucket elevators. Loss of dust is virtually eliminated.

At the Consolidated Mining & Smelting Co. zinc plant the suspension roasting method of treating zinc concentrates continues to give excellent results, according to B. A. Stimmel, superintendent. The high extractability of the zinc in the calcine, the high sulphur dioxide content of the gas, and a capacity up to 210 tons of concentrates per roaster per day all tend toward satisfactory operation.

The leaching-plant flowsheet remained unchanged, except that a second zinc-dust purification step was installed to lower the cadmium content of the final bar zinc. The extra step is accomplished by adding a second portion of zinc dust to the otherwise purified filtrate from Kelly filters and refiltering through Shriver presses. The flow through the electrolytic cells continues the same, but the plant output was increased a few tons per day by adding cells to each electrolytic unit to raise operation of the rotary coverters to maximum voltage capacity.

According to H. deNeufville, two of the smelters of the American Metal Co. —the American Zinc & Chemical Co., Langeloth, Pa., and the Blackwell Zinc Co., Blackwell, Okla.—have increased smelting operations and output.

S. H. Levison, of the American Smelting & Refining Co., reports that 560 additional retorts are being installed at the Beckemeyer, Ill., plant and that 1,600 to 2,400 additional retorts are being added to the Amarillo, Tex., plant.

The Henryetta, Okla., plant of the Eagle-Picher Mining & Smelting Co. has increased its production of preroasted concentrates by operating the Herreshoff roasters so as to discharge the calcine at about 8 percent sulphur; the previous and preferred sulphur tenor of the calcine was about 4 to 5 percent. The plant continues a 48-hour cycle on the six retort blocks. The Van Buren, Ark., plant of the same company, which has added two blocks to its capacity, continues on a 32-hour cycle in response to the increased demand for zinc concentrates.

Newfoundland Concentrates

The American Zinc Co. of Illinois purchased the idle Evans-Wallower electrolytic zinc plant at Monsanto, near East St. Louis, Ill., in October 1940. The plant, idle since 1931, is being remodeled for the standard low-density electrolytic zinc process and is to produce zinc of 99.99 percent purity at the rate of 16,000 tons per year. The plant will begin operations on Newfoundland zinc concentrates in March 1941. The concentrates will be flash-roasted at the retort smelter of the company and transported 3 miles to the electrolytic plant. Several years' supply of Newfoundland zinc concentrates is available.

A Waelz plant at the retort smelter is available for treating the residues from leaching. Waelz operation in conjunction with electrolytic plant yields a maximum total extraction of zinc. The cadmium plant at the retort zinc smelter will treat purification precipitates to recover cadmium and copper.

The electrolytic zinc plants of the Anaconda Copper Mining Co. are operating at near capacity. Eleven of the twelve units are now in operation. Each unit has a daily capacity of approximately 40 tons of zinc. Test installations of Proderite electrolytic cells were made. The cells are manufactured by mixing a silica aggregate with molten pitch and asphalt and pouring it into vibrating steel forms containing reinforcing rods. The cells are said to have strength equivalent to high-grade concrete and are very resistant to solution or acid attack.

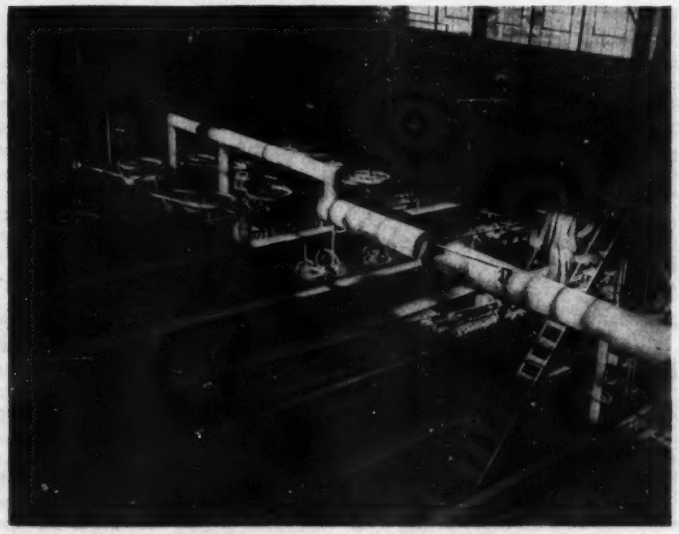
The electrolytic plant of the Sullivan Mining Co. at Kellogg, Idaho, has made full use of its newly increased capacity. Three electrolytic units of 150 cells each provide the plant with a daily production of approximately 100 tons of metal analyzing 99.998 and 99.997 percent zinc. The plant operates with the high-current-density process devised by U. C. Tainton. The major source of zinc concentrates supplying the plant is the Star mine of the Sullivan Mining Co. Other sources are the mines of the Bunker Hill & Sullivan Mining & Concentrating Co. and the Hecla Mining Co. The highly complex ore is concentrated by gravity and selective flotation. Concentrates are calcined in Herreshoff furnaces of the Sullivan Mining Co. at the electrolytic plant.

The Cerro de Pasco Copper Corporation began construction of a pilot electrolytic zinc plant last September. A zinc concentrator is under construction and will be ready for operation in 1941. The ores to be concentrated will come from virgin ground.

The differential density or float-and-sink cone concentrating process continues to expand. Ores that release minerals at 28 mesh or coarser are amenable to the process at a high degree of efficiency. The cone concentrates apparently are measuring up to all expectations of the new ore-dressing method. The process, very simple in principle, operates with uniform results in treating wide varieties of grade, shape, and size of feed, with little or no loss in efficiency. Ores suitable for jigging, and in many instances for tabling, are concentratable by the float-and-sink cone. In the first half of 1940 three established plants were treating zinc, lead, and iron ores at the rate of 5½ million tons per year. The cones were at the Mascot, Tenn., plant of the American Zinc Co. of Tennessee; the Central Mill, at Picher, Okla., of the Eagle-Picher Mining & Smelting Co.; and the Patrick, Minn., pilot plant of Butler Bros. A larger-capacity cone was put in operation by Butler Bros. near Crosby, Minn., in October 1940.

The flotation plant of the U. S. Smelting, Refining & Mining Co. at Midvale, Utah, continued treating custom lead-zinc ores in addition to ores from the company's own property. The zinc concentrates produced were treated in the electrolytic plants of Anaconda.

The Pend Oreille Mining & Metal Co., of the State of Washington, has



Flotation section of the Central Mill of the Eagle-Picher Mining and Smelting Company, near Picher, Oklahoma

opened a new zinc deposit estimated at 100,000 tons of high-grade ore. The mine adjoins the company's major operating properties near Metaline Falls. Mining operations will be carried on by open-pit methods.

Old lead-zinc mines in Idaho, including the Constitution mine, are being reconditioned for operation. It is estimated that 200 tons of ore daily will be produced from that mine.

In Montana the Elm Orlu mine, idle since 1927, when it was operated by the Clark interests, is expected to resume operations in 1941.

Zinc, used largely for the manufacture of galvanized products, brass, die castings, and pigments, plays a very important role in the national defense program. Brass and galvanized iron are used in the construction and maintenance of equipment, of warships, transports, and freighters. Brass is used extensively in ordnance equipment, communication instruments, ammunition, and land transportation units, including tanks, trucks, and passenger cars. Galvanized sheet is needed for the construction of camps, barracks, shelters, and warehouses. Zinc-alloy die castings are an integral part of cars, trucks, electrical instruments, and industrial control apparatus. Paints and pigments are essential for the protection of buildings and structures.

The erection of new reduction capacity, the increase in present smelter production, and the renewed mining activities all contribute to the growth of the industry that must be continued if national defense needs are to be met.

Lead Metallurgy

(*Continued from page* 87)

ing 48 percent lead and 20 percent zinc, is smelted in a small Traylor blast furnace. Over-all recovery of the smelter is given as 98 percent of the lead and 99 percent of the silver.

Mr. Wright reports that large tonnages of high-grade lead-zinc-silver ores await beneficiation in Peru. The Cerro de Pasco bullion contains arsenic, antimony, copper, bismuth, and tin, among its impurities. There is a 25-ton electrolytic refinery for treating the bullion made by the fluedust reverberatory, as well as a 100-ton refinery for treating the lead-blast-furnace bullion. It was stated that enough 17 percent zinc and 6 percent lead ore had been developed to supply an 800-ton (daily) concentrator for 40 years. An increase in lead smelting capacity and an electrolytic zinc plant are being contemplated. About half of the smelter's lead comes from custom ores.

The Uncommon Metals

Year marked by intensive search for domestic sources to meet requirements of defense program. Manganese and chromium hold spotlight. Production of magnesium growing rapidly

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THE TREND in uncommon metals in 1940 has been affected profoundly by considerations of national defense. Whereas in the year before efforts were still directed toward finding new uses for metals for which demand was less than supply, the picture has changed to one of an intensive search for domestic sources of those less common metals that have become indispensable as additions to the more common metals and alloys.

MANGANESE—The year's developments in manganese well illustrate the new trend. To provide in advance against recurrence of the difficulties encountered during the World War of 1914-18 in supplying manganese to the steel industry, a demand has arisen for a survey of domestic manganese ores. In response, the Federal Bureau of Mines has already made considerable progress in finding reasonably economic milling methods for recovering a ferro-grade concentrate from certain domestic ores, and Congress has set aside $2,000,000 for extending this study to all promising deposits in this country; small pilot plants for this purpose will be in operation early in 1941. The large volume of middlings accumulated by this concentration, as well as the ores from which no ferro-grade material can be separated, will be treated for recovery of manganese. A new pyrometallurgical scheme under investigation, for use in extreme emergency, concentrates manganese mainly as sulphide by matte smelting[1]; the roasted matte would be suitable for making ferromanganese. In addition, various hydrometallurgical methods proposed during and since the previous war will be tested for their efficieney and economy in providing solutions from which manganese may be recovered, electrolytically or otherwise.

There are intimations[1] that manganese-base alloys are on the verge of assuming commercial importance, which, if realized on a sufficiently large scale, should react favorably on the price of all manganese products. Something of this nature is happening now in a Southern State, where a small $70,000 plant using the sulphur dioxide process extracts manganese as manganese sulphate. Half of the solution so obtained is said to be shipped in tank cars to the Knoxville electrolytic manganese plant, and the other half, after evaporating and calcining, brings a good price in the open market. Readers would be amused to hear the local farmers, who dig and deliver the ore, talking of "raising" or "growing" manganese, and discussing the prospects of their manganese crops.

CHROMIUM—Next to manganese, chromium is the alloying metal of most strategic importance to the steel industry. Unlike manganese, however, there are no known extensive domestic deposits from which standard ferro-grade chrome concentrate can be milled; furthermore, metallurgical ore can be imported only by long-haul overseas transport. This year one rather large chrome deposit in Montana has been explored by the

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[1] R. S. Dean: "Electrolytic Manganese Alloys Get Good Commercial Start"; "Steel" Vol. 107, No. 16, Oct. 14, 1940, page 166. Also R. H. Harrington: "Manganese Base Alloys—New Metallurgical Development", *ibid*, page 162. Also Wood, C. E., Barrett, E. P., and Porath, P. R.: "Progress Reports—Metallurgical Division, 41. Matte Smelting of Manganese: Bureau of Mine Reps. of Investigations 3545, 1940, 15 pp.

Bureau of Mines; but the ore is low grade, and the chrome concentrate made from it is of the nonmetallurgical type characteristic of the majority of the world's chrome deposits. Chromite ($FeO.Cr_2O_3$) belongs to the spinel group of minerals, which are isomorphous and more often than not are found as solid solutions of several members of the group. Concentrates from American deposits are generally picotite $(Mg,Fe)O.(Al,Cr)_2O_3$, instead of chromite, and the two constituent spinels, $MgO.Al_2O_3$ and $FeO.Cr_2O_3$, cannot be separated by mechanical means. Picotite is not suitable for making ferrochromium, and its chromium content must be extracted by chemical means, usually by changing into a soluble chromate, as outlined in these pages recently.[2] It has been discovered, however, that Montana picotite dissolves readily in sulphuric acid when manganese dioxide is present, and some hope is entertained that metallic chromium may be produced fairly cheaply by electrolysis of the resultant solution. The chances of displacing the standard ferro-alloy by electrolytic metal would seem to be better for chromium than for manganese; first, because chromium is considerably higher priced than manganese; and, second, because a large proportion of the high-alloy steels containing chromium demand a very low carbon content, which cannot be attained without special still higher-priced low-carbon ferrochromium.

ANTIMONY, BISMUTH, ARSENIC—The situation in regard to antimony is about as it was reported last year, with some new deposits opening for operation and with recovery of steadily increasing amounts of antimony from smelter byproducts. One news item appearing at the end of last year, and belonging to this category, stated[3] that a new plant was under construction for recovering silver, copper, antimony, and bismuth from tetrahedrite. This may be recalled now, because at that time the bismuth appeared to have only a nominal market. Today, Cerro de Pasco's bismuth alloy, mentioned in last year's review, is qualifying as one of the best of a number of materials being tried at airplane factories for making forming dies. This comparatively cheap alloy can be easily cast to shape and size and is so strong and hard that it withstands the aluminum sheet-forming operation long enough to represent real economy over machined-steel dies and even over nonferrous dies.

[2] "Chromate Salts from Domestic Ores." *E.&M.J.* Vol. 141, No. 5, May, 1940, pp. 50–51, and 57.

[3] "Bunker Hill to Employ Unique Smelting Practice", *E.&M.J.* Vol. 140, No. 12, Dec. 1939, page 78.

Arsenic, too, made a record in 1940, in appearing for the first time as a desirable alloying element. The telephone companies have found that addition of 0.1 percent arsenic improves plumbers' wiping solder used for splicing lead cable-sheath.

COBALT—World production of cobalt is about 4,000 tons annually; most of it is consumed in the United States, where, in the past, there has been no marketed production of cobalt from domestic deposits. The lack of domestic production probably is not ascribable to absence of cobalt from American ores but rather to failure in recognizing and recovering the small quantities of cobalt occurring in many types of metalliferous ores. For example, domestic manganese ores usually carry from a few hundredths to several tenths percent of cobalt, which must be removed from the electrolyte before manganese can be deposited. A western electrolytic-zinc plant found 3.3 percent of cobalt in 16 tons of residue collected in 1938; and substantial values in cobalt have been reported from an Idaho mill floating molybdenite concentrate and from prospects in Oregon and Arizona. Furthermore, cobalt occurs in the iron ores of Cornwall, Pa., where its content is increasing as the orebodies are being mined.

Cobalt is regarded by some metallurgists as the one uncommon metal for which there is no substitute. This certainly holds for its use as the binder in carbide-tool tips, but the tonnage so consumed cannot be large; 3 to 13 percent of cobalt is needed, it is true, but the total weight of each tip is less than an ounce. A larger amount of cobalt is required for the nonferrous alloy stellite and for three types of ferrous alloys, all used for high-speed cutting tools. Cobalt is also an essential constituent of the Alnico type of permanent magnets, which have revolutionized the design of electrical measuring instruments and of radio loud-speakers. There are also important nonmetallurgical uses for cobalt, so that any domestic production resulting from the present emergency may be expected to hold its market even in normal times.

BERYLLIUM—As an antidote to the great volume of press and radio publicity released this year regarding the strategic value of beryllium and its alloys, the following is offered as expressing the views of one of the two American beryllium companies[4]: "Beryllium would have value as a light metal only in case the brittle metal itself or its major alloys could be made ductile, which is far from being in sight. The present commercial outlet for metallic beryllium is principally as a precipitation hardener for base metals. Of these by far the most important is beryllium-copper."

The domestic supply of beryllium ore, though growing faster than the demand, is not unlimited, and the supply might prove temporarily inadequate were any great demand to appear. This year's publicity has stirred prospectors whose requests for the somewhat difficult beryllium assay are embarrassing; anyone having reason to believe he has located a considerable deposit of beryl or phenacite can do no better than to submit samples to the two American beryllium producers who are on the alert for good sources of the metal.

VANADIUM, TANTALUM, COLUMBIUM (Niobium)—These three metals of the fifth periodic group have become practically indispensable, each for its own unique properties in restricted but important fields of present-day industry. American production of the metals began wholly with imported ores, but the possibility of sea lanes being closed is stimulating the development of domestic sources of supply. As for vanadium, which is widely distributed, especially in igneous rocks, the past few years have seen increasing quantities of vanadium concentrate marketed as a byproduct of flotation mills treating complex gold, silver, lead, and molybdenum ores; this, with exploitation of domestic deposits of carnotite, vanadite, and descloizite, has made the United States the largest producer at present. The situation with regard to tantalum and columbium is not so favorable; tantalum metal is still made largely from Australian tantalite and ferrocolumbium from Nigerian columbite. Tantalite and columbite commonly occur as the isomorphous mixture columbo-tantalite, whose metallurgical value is not the sum of the values of its tantalite and columbite contents; the two elements are so similar chemically that their separation is costly, and hence there is a high premium on the rare end members of the series.

In 1940 the one producer of tantalum metal and ferrocolumbium in the United States organized a systematic search for domestic sources for his products.

CADMIUM, GALLIUM, INDIUM—Of these three byproducts of electrolytic zinc refining, gallium has had a definite setback in that its substitution for mercury in dental amalgams, heralded in last year's review as an accomplished fact, has turned out to be unsatisfactory. Commercialization of indium-plated bearings is progressing, thanks probably to a boom in the airplane industry. Tech-

[4] C. B. Sawyer: "Beryllium and National Defense." *Metals & Alloys*, Vol. 12, No. 4, October, 1940, pages 426–428.

nical journals of the metal-fabricating industries have begun to advertise the services of The Indium Corporation of America.

Cadmium production and sales reached a new high in 1940; in fact, wholesale substitution of cadmium for tin in tin-base babbitts is not practiced, chiefly because the supply of cadmium is limited by the rate of production of zinc.

TITANIUM, ZIRCONIUM, URANIUM—The use of titanium and zirconium as additions to various alloys expanded during 1940, despite the fact that columbium, which shares with titanium the property of stabilizing stainless steels, appears to have gained a preference in the 18-8 used in airplane manufacture. Several articles appeared in 1940, giving further details for the preparation of ductile titanium and zirconium featured in last year's review.

Uranium, on the other hand, was definitely abandoned in 1940 as a promising steel-alloying element.

MAGNESIUM, SODIUM, SILICON—The production of magnesium metal is increasing rapidly, and a new plant for making magnesium from sea water is being erected in Texas. The Bureau of Mines direct process for reducing the metal from magnesite is about to be tried in a small-scale pilot plant.

Sodium deserves mention here because 50,000 tons of that metal are produced and consumed annually. For the same reason, a prominent metallurgist urges consideration of silicon, which acts like a metal in many ways and is used in large quantities both as element and as ferrosilicon.

MISCELLANEOUS—The supply of domestic tungsten ore has been increased, but it is not yet considered adequate for self-sufficiency. Selenium in 1940 established itself as the standard addition (0.20 to 0.25 percent) to make stainless steel (18-8) machinable. Calcium metal, which is continuously finding more applications, is now produced in the United States for the first time. Rhodium, one of the minor platinum metals, has been found to be useful for plating and is especially recommended for mirrors used in scientific laboratories. The Lithium Corporation describes a new lithium-atmosphere furnace for bright annealing, and another metallurgical firm features lithium alloys for increasing fluidity in brass-founding. Barium metal is the lubricant in a new X-ray tube with rotating target. Polonium, one of the numerous radioactive decomposition products of radium, has been advocated as a means for facilitating the passage of sparks in spark plugs, and this surefire spark plug is said to be sponsored by a well-known maker of auto accessories.

Industrial Minerals

Country's position in non-metallics much stronger than in first World War. Foreign potash now a negligible factor. Domestic production of most items on list stimulated

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WAR and preparation for war have profoundly affected those non-metallic minerals used in the production of metals required by the preparedness program. Nevertheless, the United States is now more self-sufficient in most of these minerals than in 1917, and such substances as potash and magnesite are no longer included in the deficiency list. Of industrial minerals, only mica and quartz crystal are classified as strategic, and the critical list includes only asbestos, graphite, iodine, and possibly bauxite.

ASBESTOS—Notwithstanding loss of European markets, the volume of business done by Canadian mines was about the same in 1940 as in 1939. Except for the British-Canadian mine, which closed in September, all mills were operating at capacity. Demand for short fiber brought an increase in price of approximately 10 per cent in May, but prices for other grades remained substantially unchanged. No new technical developments were reported. Prospecting was discontinued on deposits in northern Ontario, northern Quebec, and Venezuela.

Though asbestos is classified by the National Defense Commission as a "critical" mineral, only certain grades of amosite and African blue have been purchased for stockpile purposes.

BARITE—During much of the year there was little change in the price situation, although some downward trend was noted, especially in Missouri and California. Deposits in Georgia continued to enjoy the absence of normal foreign competition. In the first six months there were, however, some imports from Greece. Deposits at Malvern, Ark., are now being actively operated by two companies and a third company is installing a gravity concentrator.

The most important technical development is the successful use of flotation by one of the companies at Malvern. A product containing 93 to 95 percent $BaSO_4$ is said to be obtained. Most of the output from these deposits is expected to be used as oil-well drilling mud and will move to the West and Southwest for export through Gulf ports.

Cuban barite deposits have been further developed and a plant is under construction at Regla, in Havana Bay, to treat ore from the Organos Mountains in the Province of Pinar del Rio. Much of the output will be shipped for use as drilling mud to Trinidad, Venezuela, and Colombia.

BAUXITE—Few minerals have been so severely disturbed by the war as bauxite. The European fields in the past have been the source of more than one half the world's production. France, formerly the world's largest producer, can no longer ship to other than the Axis powers. It formerly supplied most of the bauxite used by Great Britain, which must now look elsewhere for supplies.

In Italy, bauxite output was largely consumed locally, although substantial exports were made periodically to Germany and some other countries. These shipments have to go by rail and are without doubt ended by traffic congestion. Yugoslavian production was also shipped to Germany but was discontinued by lack of railroad facilities. Similar transportation and other difficulties are also faced by the producers in Greece, Hungary, and Roumania.

Russian ore is not shipped outside of Russia.

Deposits in the Netherlands East Indies and in Malay are no longer able to export to Europe, but this loss is probably largely offset by an increase in Japanese demand.

There has been a large increase in production from the Guianas, in northern South America, the output of these mines going largely to the United States and Canada. Consideration is also being given to the possibility of exports from the bauxite deposits situated north of São Paulo, Brazil. Normally these deposits, because of their remoteness, would not be able to compete in the world markets.

The world's production for 1940 will without doubt exceed that of the previous year, and it is expected that further increases will take place during 1941. Prices have undergone little change except that caused by increased freight rates.

BENTONITE—Production of bentonite continues to increase. The progress of this industry, as in the case of diatomite, has been largely due to extensive scientific investigation of bentonite's characteristics, and research to determine its utility has had some success. It is unfortunate that those responsible for this progress have been charged with antitrust violations because of the patent position.

The chief development of new sources continues to be in the South, where calcium or non-swelling bentonite is found. Several new bentonite processing plants have been built recently in Mississippi and Alabama to prepare the product for bonding foundry molding sand.

BORAX—Because of the blockade, exports of borax to Europe, ordinarily a substantial outlet for borax and boron products, have been greatly curtailed, while domestic production has been slightly above normal. No important technical development or new sources of supply were reported. Domestic prices remained unchanged during 1940 and have been continued for the first half of 1941.

DIAMONDS—War activities have resulted in a sharp increased demand for industrial diamonds. The German invasion of Holland has transferred cutting operations elsewhere, and New York cutters are reported to be working at capacity for the first time in many years. Imports of cut stones in 1940 will probably amount to less than 25 percent of the 1939 figure.

FELDSPAR—Domestic production of pottery and general ware has been greatly increased by the stoppage of shipments from foreign countries, particularly those of Central Europe. This has called for increased production of feldspar and its substitutes, with output probably equal or exceeding that of 1937, the highest previous year.

FLUORSPAR—Increased activity in the steel and other industries has resulted in the growing demand for fluorspar, domestic production still coming largely from the Kentucky-Illinois districts. Imports have been radically curtailed, the total for the first nine months of 1940 being 10,045 short tons, of which about 70 percent was received in January. Of this amount something over 50 percent came from France. Demand for new production has not been heavy, probably owing to large stocks in consumers' hands. At the present rate of steel output, these stocks are being rapidly decreased, and demand is expected to increase during 1941.

Quoted prices fell from $22 per short ton in January to $19 in October.

No important technical developments have appeared during the year although flotation treatment continues to be extended.

ICELAND SPAR—The chief source of this material prior to the World War was from deposits near Iskifjordur, in Iceland. Operations were discontinued for several years during the War, and the deposit was flooded to protect the calcite from weathering. Upon reopening, the spar was found to be below grade of that formerly obtained, and since then supplies have come largely from South Africa, with lesser amounts from Spain. During the past year deposits have been opened in the San Pedro Mountains southwest of Santa Fe, N. M., and several hundred pounds of excellent grade spar have been shipped. Some of the crystals are reported to weigh 40 lb. or more.

KYANITE—The increasing difficulty of obtaining kyanite from India is expected to increase demand for the American product, although this and increased war activity have not yet brought about any marked increase in demand. The Phosphate Recovery Corporation of Baker Mountain, Va., has added a large air-swept, silex-lined pebble mill, calciner, and cooler to its plant and has installed power drilling equipment in the mine. This property is now being operated by the Kyanite Products Corporation, a subsidiary.

Topaz concentrates produced by the United Feldspar Corporation, Spruce Pine, N. C., are being investigated as a substitute for kyanite.

MAGNESITE—The exclusion of imports, particularly from Central Europe, and largely increased demand for refractory magnesite brought about a considerable expansion in domestic output in 1940. As in previous years, the chief producer has been the Northwest Magnesite Co. at Chewelah, Wash. Exploratory work has been carried on in California in a search for new sources of supply, but these have not resulted in any important developments.

The Westvaco Chlorine Products Corporation continues to manufacture high-grade synthetic periclase obtained from seawater bittern at Newark, Calif. The company also manufactures artificial magnesite for use in the oxychloride industry. The Dow Chemical Co. is installing a large plant in Texas to recover magnesia from seawater, but the output will presumably be used in the manufacture of magnesium metal. The Northwest Magnesite Co. plans to use flotation in the beneficiation of its raw material and has started building a 300-ton flotation plant, which is expected to be in operation by the middle of 1941.

Notwithstanding the high rate of increase in demand, prices have remained stationary.

MICA—Substantially increased demand due to war requirements and increasing difficulty of obtaining supplies from India have stimulated production from mines in the United States. The Bureau of Mines has been particularly active in this field and has examined more than 200 mines and prospects in the Spruce Pines district in North Carolina alone. Increased domestic production and supplies from South America have enabled manufacturers to maintain stocks at a fairly constant level. Samples from many districts have been tested for their dielectric powers and it is believed that in the future less dependence may have to be placed on shipments from India.

The price of smaller sizes of domestic scrap mica increased nearly twofold during 1940, and this brought about the reopening of many domestic deposits, particularly in North Carolina. This increase in price brought it closer in line with that of corresponding India grades.

Research work by the Bureau of Mines and the T.V.A. has shown that mica separated from mica schists and clay by froth flotation can be used in the manufacture of molded plastics having high dielectric strength.

The Harris Clay Co., which formerly recovered mica from clay by wet table operations, has now adopted flotation. The Kyanite Co., at Spruce Pine, N. C., also completed a mica flotation plant during 1940. Recovery of scrap mica from weathered pegmatites has reached considerable importance in North Carolina.

Hydraulicking of kaolin deposits has been discontinued, but it is still

employed at several of the scrap mica operations. The English Mica Co. for some years has been employing a micronizer for preparing certain grades of mica.

Domestic production in 1940 will probably show an increase of 30 percent over that of 1939 and further increases are anticipated.

POTASH—Potash producers in the United States, with the aid of some imports early in the year primarily from France and a small amount during the last part of the year from Spain, were able to meet domestic requirements during 1940. A third mine was opened in New Mexico and shipments therefrom started on Oct. 1. The output of this additional mine should supplant the tonnage imported in 1940, and the mine, which is a third source of domestically produced potassium sulphate, will also supply for the first time the nation's agricultural requirements for double sulphate of potash magnesia. Exports of potash in 1940 were materially less than in the preceding year.

The effect of the European war on potash has been to speed up the production of refined salts, for which there is a heavy demand. No appreciable increase has developed in the demand for run-of-mine salts. The present capacity of the American producers is about 600,000 tons in terms of K_2O, about 200,000 tons of which capacity is in the lower grades formerly imported in large quantities, but which grades are not attractive to either the domestic or export trade because of the added cost of handling per unit of contained potash. With an increase in the domestic demand for refined muriate for industrial purposes, and owing to the limited refined muriate productive capacities of producers, more run-of-mine salts may be required in 1941.

The price of muriate has remained stationary, with seasonal discounts from 53½c. a unit, except for reduction in the quoted price at Carlsbad, N. M., and Trona, Calif.

SULPHUR—As in 1939, major production of sulphur in the United States was confined to Texas and Louisiana, with but small tonnages produced in Colorado, Utah, and California. Production by the Frasch process amounted to 2,720,000 tons, or 30 percent more than the 2,091,000 tons produced in 1939. Shipments from the mines increased approximately 15 percent from the figure of 2,234,000 tons in 1939 to something over 2,500,000 tons in 1940. The close relationship between production and shipments seems to indicate an endeavor on the part of the producers to maintain stocks of approximately 4,000,000 tons, or enough to cover one and one-half to two years' requirements.

Electrometallurgy

Numerous developments in aluminum production mark year, with capacity much increased. Magnesium in spotlight. Bunker Hill starts electrolytic antimony plant.

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STATEMENTS made concerning foreign developments during 1940 may be true one day and largely modified by some war operation the next. During the year I have heard broadcasts of bombing raids, or read of such raids, on localities recognized as the sites of most of the metal-producing centers of Europe. Hence what is said must be considered with this in mind.

ALUMINUM — Developments in aluminum were so many during 1940 that one can hardly touch on all of them. At the end of 1939 the Aluminum Company of America signed a 20-year power contract for 32,500 kw. ($17.50 per kw.-yr.) from Bonneville dam to be used in a reduction plant near Vancouver, Wash. The plant was to have a capacity of 15,000 tons of metal per annum; the cost has been given as $3,000,000 to $3,500,000, and the operating force as about 200 men. It was to start by the end of 1940. In April a five-year contract for a like block of power was announced and construction started on a second 15,000-ton unit. The first unit began operations in September. In October another power contract of 97,500 kw. was announced for three more 15,000-ton units to be built at the site of the first two. The second unit started up near the end of the year, and unit three was under construction. The alumina for these units is shipped from the Aluminum company plant at Mobile, Ala., which gets much of its bauxite from Surinam (Dutch Guiana). The Aluminum company's metal plant at Alcoa, Tenn., is being enlarged 20 percent and is to increase its tonnage early in 1941. Power is partly from the T.V.A. and partly from its own power plants. Production of primary metal in 1939 was 163,500 tons. Production-rate at the end of 1940 was about 225,000 tons per annum, and was planned to be on a scale of 350,000 tons per year by the middle of 1942, including the output of Reynolds Metal Company. This company signed a contract in October with the T.V.A. for a total of 60,000 kw. It is building a plant of a capacity of 30,000 tons of metal at Sheffield, Ala. Operations are slated to start in March, to reach half capacity by the middle of the year, and to attain full capacity a year later. It is understood that bauxites from Brazil, Netherlands East Indies, and domestic sources are available.

The Walthall process of producing arlumina from domestic clays has been carried on by T.V.A. in a one-ton-per-day pilot plant at Muscle Shoals.

Canadian production of primary metal in 1939 was 82,500 tons; 1940 capacity should be around 100,000 tons. The capacity at both Arvida and Shawinigan Falls was increased during the year.

Great Britain drew on French bauxite to a large extent previous to France being overrun. Replacement of this source involves a long haul and it is somewhat of a question how much bauxite is being made available.

German production for 1940 was planned to be 10 percent more than that of 1939, when it reached close to 200,000 short tons of metal. Little of it, as heretofore, was produced from domestic raw material. To date, the success of this project must be considered metallurgical rather than commercial. Bauxite in quantity was brought from the same European sources as in 1939.

A so-called "ST-process" for recovering alumina from domestic clays

was reported to have been tried on a fairly large scale at the Lautawerk plant. The clay is decomposed by sulphurous acid, forming aluminum sulphite, which is drawn off and then broken down to alumina and sulphurous acid gas. The latter returns to the dissolving stage of the process.

Germany can probably meet her own requirements of suitable coke for electrodes, but it is a question whether she can meet those of the other Axis-dominated countries which normally import petroleum coke from the United States. Average figures given during 1940 were about 500 kg. of high-grade carbon electrodes per metric ton of metal and 20,000 to 25,000 kw.-hr. as power requirements. Utilization of scrap is complicated by the great variety of alloys produced and by the high iron content and zinc pigment of airplane scrap. It is reported that large stocks of natural cryolite were seized in Denmark. Aside from such stocks in Denmark, the continental producers must use synthetic cryolite. Germany continued intensive work on producing metal of high purity and alloys therefrom.

Report from Italy has it that the aluminum plant at Porto Marghera, which was built to use the Haglund process, is being temporarily used to produce electric pig iron from pyrite ashes—apparently another instance of lack of success to date in trying to use other than bauxite ore for making alumina. Production of alumina from leucite was found unsatisfactory during 1940. The Istrian bauxite deposits, important sources for alumina to date, are said to be nearing depletion. A second synthetic cryolite plant was scheduled for completion during 1940. The new aluminum plant at Bolzano has been slow in coming into production. Porto Marghera, near Venice, was bombed for the first time near the end of the year. Its aluminum plant is planned eventually to have a capacity of 40,000 metric tons of metal per year. A magnesium plant and Italy's newest electrolytic zinc plant are also located there.

The U.S.S.R. aluminum plant at Kamensk, in the Urals, was reported to be operating satisfactorily early in 1940. Soviet engineers were largely inexperienced with the Bayer process used at this plant and the breaking-in process seems to have been a long one. The Soviet press stated that the industry was running behind the plan. The alumina content of the furnace slag at Dneiper was too low and the sulphur content over 2.5 percent instead of under 1 percent. When over 1 percent it slows up the operating rate and the grade of alumina becomes appreciably lower. The Dneiper plant was producing about 50 percent instead of 65 percent of the national production. The Volkhov plant also uses a smelting process as the source for alumina. Total output was reported sufficient for only the most pressing uses.

Much activity but little information was reported from Japan, with a half dozen new alumina plants at various stages of a construction program and a like number of metal-producing plants, most of them relatively small.

The Norwegian industry was largely dependent on foreign bauxite and electrodes. It was principally controlled by British and French capital. The two largest plants, Eydehaver and Tyssedal, each have a capacity of 16,000 metric tons of metal per annum. The Hoyanger, 9,000 tons, makes its own alumina and electrodes. It uses the Pederson process to produce alumina and a low-sulphur iron. The small Swedish plant at Mansbo, formerly dependent on foreign bauxite, has been running on whatever scrap is available and alumina from Boliden andalusite (35 to 40 percent alumina) which is obtained from a small plant.

Hungary built a small aluminum plant at Tatabanya, and expected to more than cover the small national needs. Yugoslavia's plant at Lozovac increased the number of furnaces to 56, which have a total capacity of 9 tons of metal per day.

ANTIMONY—The Bunker Hill & Sullivan started production of electrolytic antimony in February. It can produce at the rate of 3 or 4 tons per day. The antimony comes to the smelter in the high-silver tetrahedrite concentrates of the Couer d'Alene district. Benefits of the Lee-Muir process used are that it yields a bismuth-free lead, a purer antimony oxide, and high-grade antimony.

Livingstonite concentrate from the Huitzuco district of Mexico has continued to come to the Los Angeles plant which produces electrolytic antimony and mercury. Costs have been given as $18.77 for shipping, $5 for loading and unloading and $33.85 for refining, per short ton of concentrate. Normally about one-half ton per day of antimony is produced.

The copper refinery at Hamburg, Germany, recovers electrolytic antimony from an electrolyte of antimony fluoride containing 60 to 100 grams per liter of free sulphuric acid and about 20 grams per liter of free hydrofluoric acid.

Electrolytic recovery of antimony from domestic ores was reported on by the United States Bureau of Mines.

BISMUTH—The electrolyte in common use contains about 100 grams per liter of free hydrochloric acid and 70 to 100 grams per liter of bismuth. The current density runs between 10 and 20 amps. per square foot and the cells are run at ordinary temperatures. The voltage drop must not be over 0.15 volt, or silver and lead will begin to deposit.

BERYLLIUM—Beryllium, like silicon, awaits a larger field of usefulness, pending development of a process which will produce it in ductile form.

CHROMIUM—An account of work by the Bureau of Mines on electric smelting of domestic chromium ores appears in the July, 1940, issue of *Engineering and Mining Journal* (pp. 49-51).

COBALT—Katanga, already a producer of note, found a higher grade of ore. A concentrator was to be erected at the Kabolela mine, and the roasting and electrolytic plants at Lubumbashi and Shituru were to be enlarged.

Rhokana Copper Corporation added a third electric furnace for smelting high-cobalt material in 1940. The cobalt is recovered in the slag, which is treated for recovery of cobalt salts and the metal.

COPPER—The Tacoma plant of the American Smelting & Refining Co. was enlarged in 1940 to produce an additional 1,000 tons per month. The cost was about $250,000.

Increased operation was general in the electrolytic refineries. A large increase in the amount of African copper sent to United States refineries was one of the changes forced by the fortunes of war during 1940.

In my article in the *E. & M. J.* for February, 1936, I spoke of Chile Copper Co. gradually increasing the proportion of lead anodes to Chilex anodes, as lower nitrate and iron content of the electrolyte permitted. It has since been found that the lead content of the cathode copper gradually rose as this was done. Trial of the Tainton type of anode is reported to have brought about a lowering of this lead content, and permitted retaining the higher proportion of lead anodes.

Europe's largest copper producer, the Bor company of Yugoslavia, controlled by French capital, and normally putting out about 45,000 tons of copper per year, 30 percent of which is electrolytically refined by the company, came under Axis domination during 1940.

Krompachy, in Slovakia, which put up a small second-hand electrolytic refinery prior to 1940, has found its deposit comparatively extensive, but of too low grade except for a by-product operation in producing iron ore.

Amid all the fury of war Finland has gone ahead with constructing its refinery for the Outokumpu copper plant. The plant was designed by the Archer E. Wheeler organization.

IRIDIUM—A demand for iridium to be used as contact points in aircraft developed during 1940.

LITHIUM—This metal is dealt with in Bureau of Mines publication, Information Circular 7054, revised May, 1940.

MAGNESIUM—Magnesium is another metal which is in the limelight because of the war. The Dow Chemical Co. built a plant at Freeport, Tex., which extracts magnesium chloride from sea water, dehydrates it, and electrolyzes the molten salt. The plant is rated at 6,000 tons of metal per year, and the total expenditure at $5,000,000.

German production in 1939 is given as a little over 18,000 metric tons out of a world total of 33,000 tons. The latter is estimated as about 50,000 for 1940.

Italy was reported to be planning to build a plant at Bolzano and another at Aosta, each of 2,400 metric tons per year capacity. A third at Cogne, near Rome, will use sea water to yield 1,200 tons per year.

Work on developing a process for producing magnesium from the high-grade magnesite of the Pacific Northwest was carried on during 1940. One line of attack was to chlorinate calcined ore by heating in the presence of carbon and chlorine, followered by electrolysis of fused chloride. The other was direct electrothermic reduction with carbon, followed by redistillation of the first product.

MANGANESE—The Electrolytic Manganese Corporation has been carrying forward its work at Knoxville, using the Bureau of Mines process. The plant was producing something under one ton per day at the end of 1940.

NICKEL—The overrunning of Norway stopped treatment of the Falconbridge smelter product at its Christiansand electrolytic nickel refinery. International Nickel is temporarily treating the Falconbridge product so far as it can.

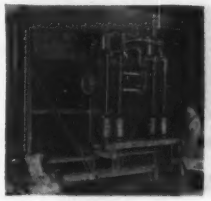
Conquest of Finland stopped International's development at Petsamo. The nickel and copper sulphides are reported so closely associated in this ore that satisfactory separation was not attained by selective flotation. A comparatively high magnesium content made smelting in electric furnaces somewhat of a problem.

The Bureau of Mines reported on recovering nickel, copper, and precious metals from Bunkerville (Nevada) ores by a combined electrothermal and electrolytic method.

TIN—The American Metal Co. in 1940 ran an electrolytic tin pilot plant on a scale of about 1 ton of tin per day.

1940 Equipment Progress

Manufacturers serving the mining industry are demonstrating possibilities for wider use of electrically operated machinery that is encouraging advances in mechanized operations underground

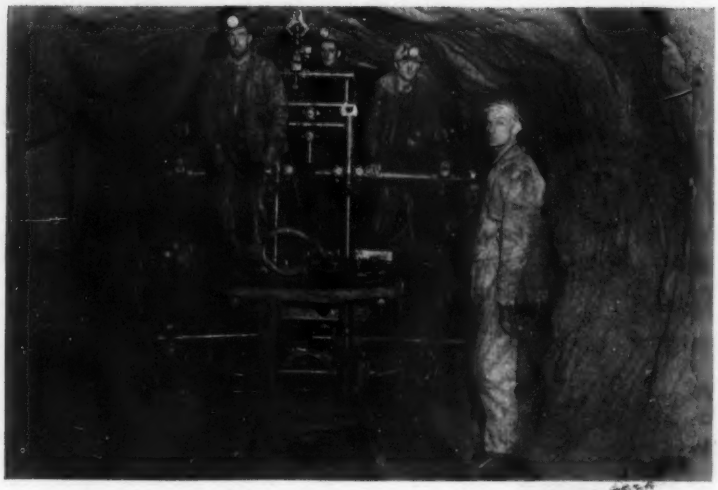


H. C. Chellson
Associate Editor

OLD MINE OPERATORS thinking of the last great war and the 1917 mining boom may be somewhat bewildered today by the action of the wealthiest nation in the world virtually stabilizing prices for copper, lead, and zinc, as well as gold and silver. The mining industry today, however, already burdened with increased operating costs and higher taxes, must accept this move as a challenge to its ingenuity to "get rock in the box" in spite of obvious economic and social changes this country, as well as the rest of the world, may be experiencing. Results of this ingenuity are becoming more apparent as problems are solved by miners and operators who contribute their ability to the collective genius of the largest group of mining equipment manufacturers in the world. This cooperative as well as competitive spirit serves to knit the domestic mining industry into one of the strongest forces responsible for a successful achievement of our national defense program.

Progress in mine and mill equipment design and application was great in 1940 and future achievements based on present-day research will probably be greater. Perhaps the most interesting advance has been that of more mining machinery motivated by electricity. Today electricity is applied to rock drills, shaking conveyors, mechanical loaders, ore-haulage equipment, air-conditioning underground, assay and melting furnaces, electric welding units, and application of numerous smaller pieces of electrical equipment. This advance is broadening the responsibility and experience requirements of the mine electrician and master mechanic in the mining industry and is recognized as an important trend leading to greater use of mechanized equipment underground. Meanwhile, operators observed other fields of equipment progress during 1940, which is briefly described herewith.

ROCK DRILLS — Conspicuous among human-relation achievements by rock-drill manufacturers is the miner's realization he is using better balanced and easier holding rock drills, whose performance far outreaches that obtained by the older and heavier types. This advance has been achieved at considerable cost and time to manufacturers, but the net gain to the industry is greater efficiency and less fatigue in the miner's shorter working week, and better drilling costs. While records were being broken in driving tunnels during 1940 with drifter drills, miners were also concerned about stopers that drill the "pay streak." The last year has witnessed greater advances in stoper design. After three years of investigations and five redesigns, the Ingersoll-Rand Co., Phillipsburgh, N. J., introduced its R-58 and R-48 stoper drills of 116 lb. and 96 lb. respectively. This type of rock drill assumes a natural drilling position because of its center of gravity. An interesting air-operated device, known as the Jackleg, was also introduced by this company to permit quick mounting of a Jackhamer for drilling horizontal and angle holes. A self-rotating stoper R-104, of the Gardner Denver Co., Quincy, Ill., weighing 120 lb., was reported in wider acceptance in 1940. Among light-weight drifter drills this company announced its D-73, a 2¾ in. bore machine weighing 118 lb., suitable for small headings. Among sinking drills the company introduced its S-73 and S-33, weighing about 70 and 30 lb. respectively. Independent Pneu-



Breaking world records in driving the Carlton drainage tunnel in Cripple Creek, Colo., demonstrates the efficiency of present-day mining equipment. Detachable bits are used on five modern drifter drills, mounted on the above compactly designed jumbo. From Sept. 8, 1939, to Dec. 23, 1940, 24,747 ft. were driven for an average of 53.22 ft. per day

matic Tool Co., Chicago, Ill., brought out its 580 automatic stoper, featuring the Thor valve design and rotation control of the drill steels. A self-rotating stoper weighing only 96 lb. and equipped with new and improved features and called the S-91, drilling 2⅞-in. holes, was announced by the Sullivan Machinery Co., Michigan City, Ind. A drill that aroused interest during the year was the new high-speed electric driven rock drill for blasting purposes using diamond-impregnated Koebelite bits, introduced by the Sullivan Machinery Co. This modern unit has a special G.E. motor using 440-volt current operating at 1,800 to 3,000 r.p.m. Automatic or hand-feed mechanisms are provided and the maximum drilling depth exceeds 175 ft. During 1940 some of these machines were being used in Minnesota iron mines and some mines in the West. This company also announced an improved design of its detachable bit that provides broad chopping and reaming edges. For the rapid heating of Jackbits for resharpening, the Ingersoll-Rand Co. introduced its Jackfurnace. A combination drill steel cutter and shank grinder, said to cut ⅞-in. drill steel in two seconds, was also announced by this company. Hayes Steel Products, Ltd., Meritton, Ontario, Canada, announced its Hayes threadless detachable bit that fits securely into a dovetailed slot in the drill shank.

DIAMOND DRILLING—Speed in "setting" or "resharpening" a diamond-drill bit was a prominent contribution to the industry by the Carboloy Co., Inc., Detroit, Mich. Instead of hand setting a new diamond bit, sharpening is accomplished by sand blasting a bit, that is composed of a cemented carbide matrix into which has been impregnated industrial virgin bort diamonds forming the crown of the bit. This matrix is said to be so hard that in drilling highly abrasive material, wear is just sufficient to maintain proper cutting clearance for the diamonds. This new technique was announced in 1940 following three years of experimental work in core drilling in iron, copper, gold, and lead mines. Sprague and Henwood, Inc., Scranton, Pa., and The E. J. Longyear Co., Minneapolis, Minn., have been appointed agents by the Carboloy company for these "Sinta-Set" bits.

Seeking to improve sludge and core sampling The E. J. Longyear Co. introduced a tilting-box type sludge sampler that automatically cuts a predetermined portion (from 5 to 20 percent) of the total sludge. It is recommended where the exact weight of the total sludge washed up is not required. This company also introduced a hydraulic core splitter, handling cores up to 2⅜ in. in diameter. An electric diamond drill operated by an 8-hp. electric motor for blast-hole drilling was announced by Boyles Bros., Co., Ltd., Vancouver, Canada. This new unit features a hydraulic clutch and transmission combined.

COMPRESSORS — Chicago Pneumatic Tool Co., New York, announced as the name implies its new "Package Type" stationary compressor, available in capacities of 300 to 800 cu.ft. per minute at 80- to 125-lb. pressure. The CP two-stage and single-stage horizontal duplex compressors in capacities of 350 to 10,000 cu.ft. per minute for pressures of 80 to 125 lb. were reported to embody some 1940 refinements in design. Ingersoll-Rand announced the largest in its line of portable two-stage air-cooled units, the K-500 delivering 500 cu.ft. per minute at 100-lb. pressure. Features of this unit are reported to be a choice of either oil engine or a new-type six-cylinder gasoline engine not requiring high-grade gasoline; replaceable cylinder liners for engines, and a patented automatic fuel saver which changes the engine speed according to the use of compressed air.

EXPLOSIVES—A new series of explosives announced by Atlas Powder Co., Wilmington, Del., is the Atlas Amodyns, reported to have increased spreading action and to offer lower blasting costs. The company also announced a luminous-dial galvanometer for testing electric blasting caps. In actual practice many holes were reported checked with this new device in half the time required with non-luminous dial galvanometer.

Development of a new high-density "Nitramon A" was announced by E. I. duPont de Nemours & Co. in 1940. This grade is said to give an increase in loading density about 7 percent for cans of 7-in. diameter and up. Size of cans has been made smaller, the range now beginning at 4½-in. diameter to 9-in. diameter for large drill holes. DuPont engineers also introduced a new bench-type cap crimper that has two smooth continuous internal beads on the throat of the cap that grasps the fuse so closely that a waterproof seal is made without requiring waterproofing compound. Unique and entirely new in coal-breaking practice, and of thought-provoking interest to metal and non-metallic miners, is the duPont hydraulic coal-mining process that accomplishes the work previously performed by explosives. In this process an electrically driven hydraulic pump forces oil from a storage tank through a hose into an expansible tube placed in a drilled hole. Expansion of the tube under the oil pressure breaks the coal along its natural parting lines, thereby completely eliminating explosion, flame, or noxious fumes.

For use in tamping explosives, the Tamping Bag Co., Mt. Vernon, Ill., developed a light-weight stemming material for use in metal mines where the carrying of clay dummies is a problem. Claiming to increase the effectiveness of an explosive charge, the Heitzman Co., Glendale, Calif., offered a blasting plug consisting of a soft thimble-shaped rubber cup and a conical wooden wedge for insertion into rock-drill holes, instead of using tamping material. A spongy substance, that will not freeze, is fireproof, and known as Colcot tamping material, was announced by the California Cotton Mills Co., Oakland, Calif.

MECHANICAL LOADING — During 1940 this relatively new practice of disposing of broken rock by me-

chanical loaders instead of the trustworthy "muck stick" continued to grow, finding not only greater use in large mines but more acceptance in the medium-sized and small operations. Some 1940 installations and the condition of operations are briefly recorded herewith. At the Golden Anchor Mining Co., French Creek, Idaho, a Gardner-Denver GD-9 loader has been in operation two shifts a day since last March, loading ore in a 5x7-ft. tunnel being driven to improve mine ventilation. Advance averages 4 ft. per shift, with 14 cars of rock removed each shift. The machine is also used to remove ore broken in stope preparation. At the Triumph Mining Co. property, at Hailey, Idaho, three Gardner-Denver and two Eimco-Findlay loading machines have been installed. Slushing operations at this property are done by 18-Sullivan D 211 electric tugger double-drum hoists. Quicksilver ore production at the New Idria mine, in California, is now being facilitated by a Sullivan HL-2 loader in deep-level development. The Combined Metals Reduction Co., with offices at Stockton, Utah, recently placed three Eimco-Findlay and Gardner-Denver loaders in operation at its flatly bedded zinc-lead ore deposit in Pioche, Nev. At its property at Lark, Utah, in the Bingham district, an Eimco and a Sullivan machine is now being used in following development of a fissure vein. Lower costs in tunneling operations are reported.

The Silver Dollar Mining Co., Wallace, Idaho, acquired a small Gardner-Denver loader for use in a 6x8-ft. drift in shale and quartzite. Holes are drilled about 7 ft. and about 40 tons of rock are broken, which is removed by the loader at a rate of 20 tons per hour. One-and-a-half-ton cars are used. The loader operates on 16-lb. rails on 18-in. gage track. About $1 per foot of tunnel is saved at this mine.

New loaders at the Sunshine Mining Co.'s plant, Kellogg, Idaho, contributed further efficiency to the nation's largest silver producer. In 1940, Eimco-Findlay 11 and 12B loaders and Gardner-Denver GD-9H loaders were acquired for use in mucking out drifts and crosscut headings and to remove ore broken in stope preparation and raising operations. Time for loading 20 cars of 28-cu.ft. capacity ranges from 1 hr. 40 min. to 2 hr. This time includes tramming to dumping point. Actual loading time per car varies from 1½ min. to 2¼ min.

In Mexico, the Cia Real del Monte y Pachuca Mines, at Pachuca, employs eight air-powered loaders in stope preparation and in driving long headings. Three loaders were recently placed in operation at the property of the San Francisco Mines of Mexico, Ltd., State of Chihuahua.

In Canada, at the Lake Shore mines, Kirkland Lake, Ontario, four machines were placed in operation in drifts and crosscuts for mucking out the rounds. Size of heading is about 7x7½ ft., the break for each round being about 25 tons. Each machine mucks out two headings in an 8-hr. shift.

Late in the year under review Eimco Corporation, Salt Lake City, Utah, announced the development of a new mucking machine, air or electrically operated, known as the "Tonneloader," which is said to have a number of features that permit loading the largest cars used underground with speed and economy.

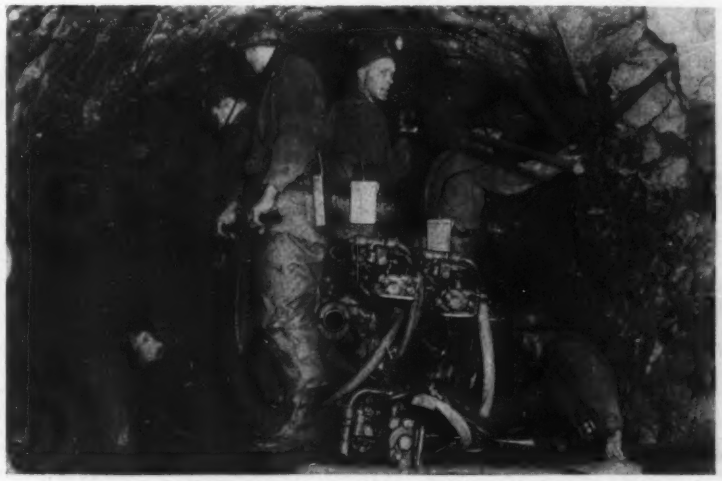
For use in slushing operations, Ingersoll-Rand announced a new compact scraping hoist capable of passing through an opening 13x15 in. This unit, air or electric driven, weighing 250 lb., was designed for small scraping jobs in narrow veins and stopes.

SHAKING CONVEYORS — This type of equipment has become better known in coal mining since 1932 and only recently is being thoroughly investigated by some copper-mining companies in Arizona. Equipment is supplied by Goodman Manufacturing Co., Chicago, Ill., and the so-called formulas of motions developed by the company for this type of equipment involve the grade (slope) and specific gravity of the material to be moved and its coefficient of friction. From these data is calculated the tonnage that any particular drive or trough can convey. The material falls on a long trough, which is given a short jerky motion by an electric motor, thereby conveying and advancing the material to a discharge point.

At one copper mine investigation is under way with five Goodman type G-12½ drives with Size 1 troughing and six more G-15 drives will soon be installed. Another copper mine has had one Goodman shaking conveyor in service for seven months in undercut-caving operations for the purpose of conveying ore from extraction chutes to a transfer raise. It has been in competition with double-drum slushing equipment. To date it has been found that the shaking conveyor will handle more than a 42-in. scraper. Maintenance costs are satisfactory and operating costs are under those of slushing, and from a safety standpoint no new hazards are introduced. Additional conveying units are now being installed to meet varying requirements as to size of ore and length of travel which should further determine their adaptability to metal mining. One G-12½ shaker with No. 2 troughing is now used, with five Type G-15 drives with No. 3 troughing being installed and five more ordered for March, 1941.

Another copper mining company in Arizona will soon install two Type G-15 drives with No. 3 troughing.

WIRE ROPE—Research by wire-rope manufacturers is contributing important benefits to the mining industry, where their products are meeting the requirements of mechanized mining. The Macwhyte Co., Kenosha, Wis., now features a method of lubricating large-diameter ropes externally with a compound which is said to retain its viscosity and adhesiveness through a wide range of temperatures. A. Leschen & Sons Rope Co., St. Louis, Mo., recently started production of a type of wire rope said to have special advantages for use in the mining industry.



Loading and tamping the dynamite in Carlton tunnel is done after the jumbo "folds up" and virtually shrinks into a small package with the drills compactly arranged on the jumbo platform. In driving the fifth mile a total of 181,104 lb. of semi-gelatin 60 per cent dynamite was used, or 34.3 lb. per ft. of advance

An interesting advance in the production of wire rope is reported by Bethlehem Steel Co., Bethlehem, Pa. A process known as bethanizing is now being applied to wire rope. In manufacture, the wire is first drawn to a predetermined gage which is considerably greater than that required in the finished product. After some preparatory operations the wire is passed through the electrolyzing cells, where a zinc coating of the desired thickness is deposited on the wires. From this point the wire is drawn to the finished rope-wire diameter, exactly in the same manner in which bright rope wire is drawn. Thus the temperature effect of the hot-dip galvanizing method on the cold-drawn finished wire is entirely avoided, and the structure of the steel in bethanized rope is hence identical with that of the steel in a rope which has not been galvanized.

ORE HAULAGE—Greater speed in drilling, breaking, and loading ore at the face has necessitated greater speed in mine haulage practice. An important advance offered to smaller mining operations confronted with the problem of greater speed, is the portable mine car transfer designed to operate on track gage of 18 in. up to 24 in. announced by the American Mine Door Co., Canton, Ohio. Of unusual interest is the new use of a rubber-tired d.-c. operated shuttle car, in a large potash mine in New Mexico. Announced by Joy Manufacturing Co., Franklin, Pa., the unit hauls ore in a sublevel to chutes that feed the main haulage level. A new midget storage-battery locomotive, actual dimensions of which are determined by the storage battery and track gage requirements, was announced by Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. A new explosion-tested mining locomotive of 33 hp. was also offered by the company. A 1½-ton storage-battery trammer with outside demountable wheels adjustable between 18- and 24-in. gage track was introduced by the General Electric Co., Schenectady, N. Y. The company also announced a design in electric mine locomotive with an over-all height of only 26 in. of 15-ton capacity.

The rapidly increasing trend of transporting ores, concentrates, and tailings by trucks and trailers has produced lower costs for many mine operators. A visit to the Tri-State zinc mining area or the open-pit mining operations in the Iron Country presents convincing evidence of this trend. A greater use of low-alloy steels, such as Mayari R steel, in trailer trucks for hauling zinc tailings is reported by the Bethlehem Steel Co. A device for a simple and quick braking system for mine locomotives was perfected by the Jeffrey Manufacturing Co., Columbus, Ohio. The complete unit consists of a tank, motor, accumulator, control valve, and brake cylinders and can be quickly installed on a mine locomotive. For punching holes for track bolts and rail bonds the Mine Safety Appliances Co., Pittsburgh, Pa., announced its velocity power rail punch, a self-contained, portable tool utilizing the energy from a blank cartridge for punching holes that are clean, smooth, and free of burrs. Another 1940 tool by this company, also operated by a cartridge discharge, was a cable splicer. It compresses a copper sleeve tightly about the two butted ends of a broken cable, giving a splice of small diameter which allows application of field insulation.

Mechanical loaders in the Carlton tunnel have been employed since the beginning of the undertaking and are responsible in a major capacity for the rapid advance of this project. In the fifth mile, 19,569 cu.yd. of material were excavated, requiring the mechanical loading of 19,569 mine cars of 3-cu.yd. capacity

The latest automatic coupler for mine cars of the Ohio Brass Co., Mansfield, Ohio, uses rubber-buffing pads for cushioning car bodies from jolts and impacts normally relieved by draft springs. The automatic drop-bottom car offered by American Car & Foundry Co., New York, N. Y., was reported in wider use for rapid unloading.

CRUSHING AND GRINDING—Requirements of the growing number of smaller mining operations have developed a trend in designing smaller and more economical types of crushers. Smith Engineering Works, Milwaukee, Wis., announced its "intercone" crusher for the smaller operation. Requiring little headroom, the unit crushes material in the upper zone and automatically spreads material as it moves downward through the lower crushing zone to the discharge opening. Maximum feed is 2¼ in. and power required is from 15 to 20 hp. A new development by the Nordberg Manufacturing Co., Milwaukee, Wis., is its 2-ft. short-head Symons cone crusher designed to meet requirements of small plants. This crusher automatically returns to its original setting after tramp iron has been passed. The unit is designed for operating at ½-in. to ⅝-in. settings, with capacities from 9 to 25 tons per hour. Among larger crushers the Traylor Engineering & Manufacturing Co., Allentown, Pa., introduced some refinements to its Traylor-Stearns fine-reduction crusher that has two crushing stages.

Improvements to the Kue-Ken crusher of the Straub Manufacturing Co., Oakland, Calif., include an automatic pressure switch, which provides the safety feature of non-operation of the crusher if oil is not circulating. An overload safety device instantly disengages the flywheel if tramp iron enters the crusher, and also stops all feeding material behind the crusher. Allis-Chalmers Mfg. Co., Milwaukee, Wis., added a larger-size gyratory crusher to its line, designated as the No. 636 Type R.

The Marcy open-end ball mill of The Mine & Smelter Supply Co., Denver, Colo., is reported to be finding wider application. The feature of this grinding mill is the discharge of the pulp on the up-turning side of the mill. A trend in tube-mill design by this company for regrinding various types of concentrates is the use of grates in the discharge end of the mill. Following considerable experimental work, a large Canadian mining company will instal Marcy open-end rod mills. The Massco-Automatic density controller has a refinement in practice that permits the charting of pulp density for the day's operation, by means of a Bristol recording attachment to the controller. A new Massco-McCool pulverizer for assay

office use that eliminates gears and oil leakage was announced by the company. The unit has a gyratory motion in the grinding disks and is operated by a V-belt motor drive.

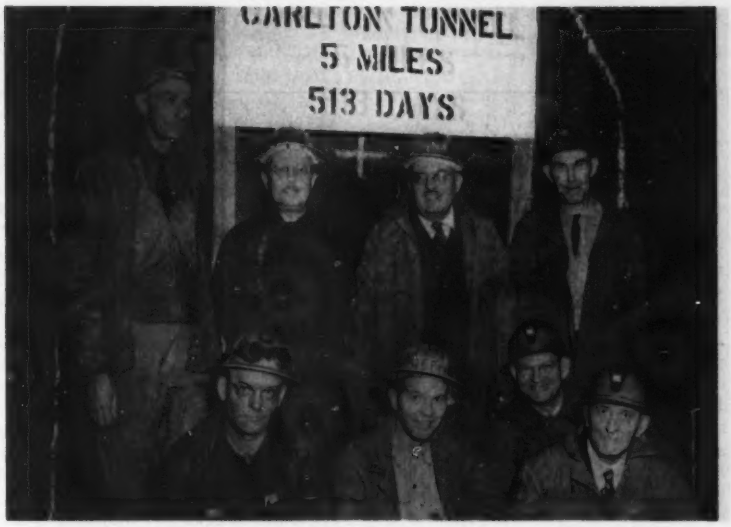
Southwestern Engineering Co., Los Angeles, Calif., brought out an electric operated vibrating launder designed to supply the need for an efficient mechanism for closed-circulating ball-mill classifier circuits without the use of extra large radius ball-mill scoops or extra length classifiers.

CLASSIFIERS—The gap between the practical limit of fine screening, 6 to 10 mesh, and the former limits of coarse classification, 28 to 35 mesh, was filled in 1940 by an entirely new type of classifier operating in 4 to 28 mesh range by The Dorr Co., Inc., New York, N. Y. This unit differs from the standard Dorr classifier in that the lower end of the tank is decked over and surmounted by a small pool in which the separation takes place, rather than in the tank proper. The company also expanded its line of classifiers to comprise four different types in a range of eleven different widths to cover virtually every type and size of milling operation. The Dorrco sand wheel introduced in 1940 is a device for elevating mill discharge to classifiers in closed-circuit operations where the classifiers are so wide (8 ft. and up) as to make it difficult to obtain an all-gravity circuit.

Western Machinery Co., San Francisco, Calif., announced a new line of screw-type classifiers, having flights equipped with removable wear-resistant shoes. These classifiers are equipped with motor-driven screw-lifting mechanism with automatic regulation.

A simplified mechanism requiring no cams or rollers for operating its line of classifiers was announced by Morse Bros. Machinery Co., Denver, Colo. The mechanism for actuating the rakes consists of heavy, fully welded, channel-iron drive arms, cast-iron rocker arms, and a heavy plate member attached rigidly to the rakes.

CONVEYING AND BELTING—The longest conveyor-belt installation in the world was completed in 1940, for the construction of Shasta dam in California. Gravel is conveyed 9.6 miles on 36-in. wide conveyor belt to a washing plant, where small amounts of gold are removed in eight two-cell Pan-American jigs. The washed gravel will be used in dam construction. Equipment for this unusual installation was considerable, the Goodyear Tire & Rubber Co., Akron, Ohio, supplying 20.4 miles of this belt, and the Chain Belt Co., Milwaukee, Wis., 50,500 malleable castings and 16,000 troughing idlers, and rollers that run on 83,000 Timken tapered roller bearings.



At the five-mile mark, reached after 513 working days drilling through massive granite, a photograph commemorates the event. Back row left to right, John R. Austin, superintendent; O. P. Tanner; Merrill Shoup, president; A. H. Bebee, manager of mines. Front row, Robert Welch, master mechanic; J. G. Farmer, engineer; Max Bowen, manager of milling; and Mr. Strickler, counsel

A Plastikon rubber putty produced by the B. F. Goodrich Co., Akron, Ohio, found an interesting application in the electrolytic tank house of the Phelps Dodge Refining Corp., El Paso, Tex., where it replaced ordinary window putty that would crack. Pioneer Engineering Works, Minneapolis, Minn., announced its traveling grizzly feeder designed to feed a steady stream of large rock to a crusher and bypass dirt and small material around the crusher. The Allis-Chalmers Utah feeder has been improved by the use of heavy wood supporting reeds, which eliminate fatigue and provide uniform conveying action free from variations.

WEIGHING—Refinements in recording were principle 1940 advances in this equipment. A new weighing feeder which incorporates a direct recording and totalizing attachment was announced by the Hardinge Co., York, Pa. A weighing machine for feeding small amounts of dry chemical reagents in a continuous stream to an exact weight was brought out by Syntron Co., Homer City, Pa. The rate of feed, beginning at ounces per hour, is set by the poise on the scale beam. A device for use in weighing sticky concentrates was announced by Merrick Scale Mfg. Co., Passaic, N. J. As the belt conveying such sticky material on the machine takes on weight, the increase will balance itself out each side of a pivot point on this new weightometer, thereby recording accurate weight.

FLOTATION EQUIPMENT—During 1940 a new development was announced by The Galigher Co., Booth-Thompson Metallurgical Division, Salt Lake City, Utah, that was incorporated in the company's Agitair flotation machine to take advantage of improvements brought about through the counter-current froth-flow system in flotation machines. Essentially, this method of treatment provides for removal of froth at one or more points, usually the head cell in a given series. The company's Agitair flotation machine has been completely redesigned, allowing greater flexibility in installation and operation, without increasing power requirements. The company also announced the development of a line of rake-type classifiers, and air-lift type agitators and mechanical type agitators.

The American Cyanamid Co., New York, N. Y., announced late in 1940 its new level-type Fagergren flotation machine, which eliminates the necessity of a drop between cells. The "clover-leaf" which provided the recirculation in the older types of machine has been eliminated and instead the rotor-stator assembly has been raised slightly off the bottom of the tank. The company also brought out a new member of its Aerofloat family designated as Aerofloat 33. This reagent is similar in properties to reagent 31 but is a stronger promoter in flotation, particularly in lead-silver ores.

Denver Equipment Co., Denver, Colo., introduced its No. 21 Denver "Sub A" deep-type flotation cell, which is said to reduce floor space requirements 25 to 50 percent for equal flotation machine volume, and lower horsepower per cubic foot of volume.

(*Continued on page* 128)

USEFUL OPERATING IDEAS

Flame-Hardening Pump Liners

A TEXAS sulphur mining company has installed special equipment for flame-hardening pump liners, to overcome abrasive conditions encountered in mud drilling. Formerly it had been necessary to specify liners of highly wear-resistant steel. Investigations showed, however, that a relatively soft steel, S.A.E. 3140, could be flame-hardened economically to between 625 and 650 Brinell and that the service life would equal that of the costlier steel. Savings per liner, taking into account the entire cost of operating the flame-hardening machine, amounted to $18.50 each.

The flame-hardening machine used has proved successful and in seven months has more than paid for its cost. It is designed to take care of several flame-hardening operations, but in particular the hardening of the inside and outside surfaces of cylinders. It employs the vertical, progressive spinning method in which the part to be hardened rotates at a set speed while the flames move lengthwise along its spinning surface, followed by a water quench. The equipment consists essentially of a column on which a crosshead moves by means of a lead screw and variable-speed drive. The hardening apparatus is hung rigidly below the crosshead and moves with it, traversing the work surface from bottom to top. An independent chuck, operated at varying speeds by a gear box and motor, spins and holds the cylinder in its hardening position.

For hardening the inside surfaces of liners the type of head used is shown in the illustration. It consists of a "pancake" of brass, machined out at bottom and top to form the water and gas chambers, the water quench forming an integral part of the head. Different sizes of heads are used to fit various inside diameters. The head arrangement (not shown) for hardening the exterior surface of other types of equipment, such as shafts, piston rods, and pump plungers, consists of a number of heads arranged in a circle. Any outside diameter of liner can be accommodated up to the limits of the machine by moving into position the number of heads required. The hardening heads for either inside or outside surfaces are assembled as units. Blowpipes, gages, hose, and manifolds are common to both.

The machine installed by the sulphur company has been in use about a year, producing about 100 hardened liners a year, of exceptionally high quality. Depth of flame-hardened case is approximately $\frac{1}{8}$ in. and is uniform over the entire length. After hardening, the surface can be given a mirror-like sheen by a light hone with fine paper and oil.

Typical flame-hardening set-up for raising the surface hardness of pump liners. Top, right, close-up of the hardening head. The rows of orifices for the water quench and, above, the flame orifices can be seen.

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Solving a Drainage Problem

MINE DRAINAGE in old tunnels often presents a difficult problem. Such a situation confronted the Cornucopia Gold Mines in the spring of 1939, when it was found that, due to the ever-widening area opened, and consequent increase in ground-water flow, the capacity of the main-line, low-level transportation tunnel, 6,200 ft. long, was insufficient to carry the water in the ditch, writes A. V. Quine, general superintendent at the property mentioned.

As time was of greatest importance, both in view of the ever-rising water from the annual spring and summer run-off and the possibility of production tie-up, the company decided to raise the track instead of increasing the size of the ditch. The plan involved the laying of 8 8-in. stringers tied in, as shown in the sketch, with the 40-lb. and 60-lb. rail laid lengthwise along the top of the stringers. To correct for possible future mis-

alignment, the stringers were braced every 150 ft. to the tunnel sides.

Supplies were purchased, the 8x8-in. stringers "dapped," and during regular ore-train trips all timber, rails and bolts were distributed the full length of the tunnel. When all was in readiness the mill bins were filled and actual track-raising was begun.

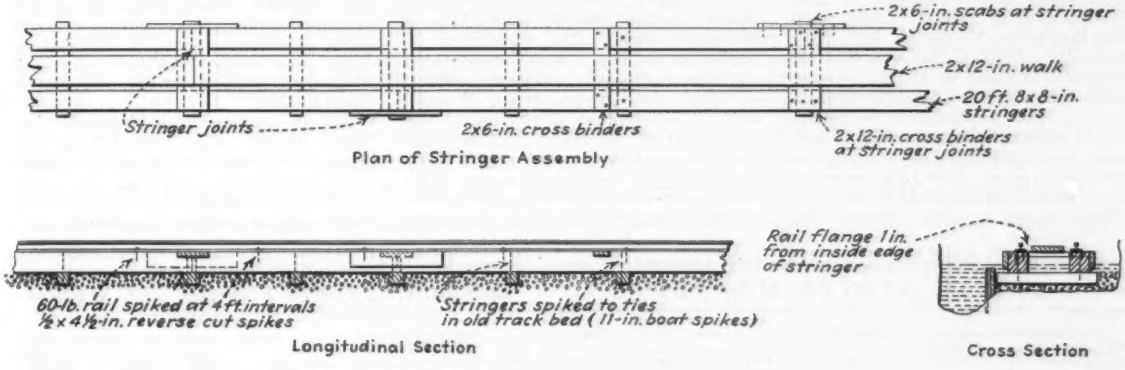
Three shifts consisting of two crews each, working from both ends of the tunnel, finished the 6,200 ft. in three days and two shifts, the first ore train rolling over the new track on the morning of the fourth day.

Labor distribution was as follows: Each crew was composed of 2 men laying stringers, 3 men laying track, 1 man boring holes for the boat spikes, 2 men pulling the old track, 2 men spiking stringers to ties and bolting rails, 2 men cleaning the old track preparatory to laying stringers, and 1 water boy for both crews on each shift.

The greatest advance by one crew in 8 hr. was 450 ft. The greatest advance for all crews in 24 hr. was 2,250 ft. Average track footage per man-shift was 21.6 ft.

The entire job was done under adverse water conditions both overhead and underfoot, many of the 8x8-in. stringers being floated into position.

The costs shown represent only those entailed in the actual relaying and raising of the track and do not involve the costs of preliminary work such as widening the tunnel in various places, re-timbering, ditch cleaning, and necessary supplementary outside dump and mill bin rehabilitation which were later charged to the job. The latter work included five switches and roughly 600 ft. of track, so that for the final total cost of $10,718 and 6,800 ft. of track, the cost per foot amounted to $1.57.


2x6-in. scabs at stringer joints
2x12-in. walk
20 ft. 8x8-in. stringers
Stringer joints
2x6-in. cross binders
2x12-in. cross binders at stringer joints
Plan of Stringer Assembly
60-lb. rail spiked at 4 ft. intervals
½ x 4½-in. reverse cut spikes
Stringers spiked to ties in old track bed (11-in. boat spikes)
Longitudinal Section
Rail flange 1 in. from inside edge of stringer
Cross Section

Simple Treatment for Wood Handles

IN THE OPERATION of mines or quarries, one task which falls to the lot of the repairman is the replacement of the handles of picks, hammers and similar tools. If such tools are left in the rain or wet underground workings, no matter what the quality of the wood, they do not long remain smooth and straight, writes Charles Labbe, from Johnnie, Nev. When replacement is important it has been found that if they are painted or given a coat of linseed oil, their life is materially lengthened.

In one plant, for treatment, a piece of 3-in. pipe, 4 ft. long and fastened to a wall of the shop, is used. The pipe is closed at the bottom end by a cap and a ¼-in. faucet tapped about half way. The pipe is filled two-thirds full of linseed oil, and the new handles are treated as follows: a small nail is driven partly into one end, a piece of wire is fastened to it and bent so as to hook over the upper edge of the 3-in. pipe, being of such length that the whole handle will be immersed in the oil. Here it remains for a day or two, after which it is taken out and hung just above the pipe so that the surplus oil will drain back into the pipe. When necessary, oil is added to make up: when too much is in the pipe, as when two handles are treated at one time, the excess can be drawn off by the faucet on the side.

The cost of such an arrangement is small.

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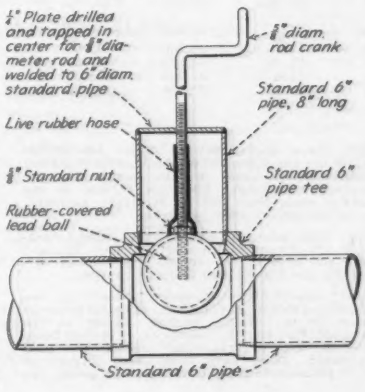
Device Keeps Pump From Surging

THE FLOTATION PLANTS of the Tennessee Copper Company, Copperhill, Tenn., have a number of centrifugal sand pumps in operation, writes Tom Postell, foreman of the London plant. The amount of material to be moved by each pump varies, so a pump must be run at a speed fast enough to handle the maximum amount. This, of course, causes it to surge when it is handling less than capacity for that speed. To eliminate the surging a very simple control valve was built and installed in the suction line to regulate the flow of pulp to the pump. A description follows:

An 8-in. length of standard 6-in. diameter pipe was screwed into a standard 6-in. tee. The open end of the pipe was closed by welding on a ¼-in. plate that had been drilled and tapped in the center for a ⅝-in. diameter rod. A ⅝-in. rod was threaded about 15 in. on one end and a crank formed on the other end. A worn Dorrco pump valve, which is a 5½-in. outside-diameter rubber-covered lead ball, was also drilled and tapped. The valve was assembled as shown in the diagram below.

Pulp flow to the pump is regulated by raising or lowering the ball in the pulp stream. The pulp is very abrasive, and it has been found that rubber will stand the wear better than any other substance that could be used. This simple valve has proved a very effective means of preventing the pumps from surging.


¼" Plate drilled and tapped in center for ⅝" diameter rod and welded to 6" diam. standard pipe
⅝" diam. rod crank
Standard 6" pipe, 8" long
Live rubber hose
⅝" Standard nut
Standard 6" pipe tee
Rubber-covered lead ball
Standard 6" pipe

Summary of the

MARKETS

THE inability to satisfy zinc consumers finally resulted in the appointment of a priorities committee for nonferrous metals late in January. Demand for copper, lead, and zinc was fairly active throughout the month, and it was felt in the industry that some of the buying was inspired by fear of possible drastic action to control distribution. Excepting tin, consumption of metals was well sustained. Authorities in Washington continued to exercise indirect control over prices, giving increased attention to secondary metals.

Prices showed no great change. The *E.&M.J.* index of prices for January was 82.48, which compares with 82.42 in December.

The Metals Reserve Company purchased another 100,000 tons of Latin American copper. The Government is perfecting a plan to make such copper available to domestic consumers working on other than defense needs, if necessary. Excitement about the future supply situation moderated. Large mine operators held to 12c., Valley, and again consumers who insisted on nearby metal paid a premium to small producers and custom smelters. Priorities in copper are not expected. Buying of foreign copper by the Metals Reserve has lifted pressure from that division of the market.

Sales of copper in the domestic market for January totaled 104,249 tons, against 90,164 tons in December. Consumption of copper in this country during January probably exceeded 100,000 tons.

Lead sold in good volume on the unchanged basis of 5.50c., New York. Stocks of lead refined in this country amounted to 40,926 tons at the end of December.

Canada shipped 5,575 tons of slab zinc into the United States during December. Prompt zinc remained extremely tight. Producers allocated business in Prime Western on the basis of 7¼c., St. Louis. High Grade zinc was almost unobtainable.

Tin strengthened late in January on higher freight rates. The shipping situation has made it difficult to quote on imported ores. Quicksilver was firmer on reduced shipments from the Pacific Coast, due to weather conditions.

UNITED STATES MARKET

1941 Jan.	Electrolytic Copper Domestic (a) Refinery	Electrolytic Copper Export (b) Refinery	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
1			Holiday			
2	11.800	10.200	50.100	5.50	5.35	7.25
3	11.900	10.200	50.100	5.50	5.35	7.25
4	11.775	10.100	50.100	5.50	5.35	7.25
6	11.850	10.200	50.100	5.50	5.35	7.25
7	11.800	10.175	50.100	5.50	5.35	7.25
8	11.775	10.125	50.100	5.50	5.35	7.25
9	11.775	10.200	50.100	5.50	5.35	7.25
10	11.950	10.200	50.100	5.50	5.35	7.25
11	11.775	10.125	50.100	5.50	5.35	7.25
13	11.800	10.150	50.100	5.50	5.35	7.25
14	11.775	10.150	50.100	5.50	5.35	7.25
15	11.775	10.175	50.100	5.50	5.35	7.25
16	11.805	10.450	50.150	5.50	5.35	7.25
17	11.860	10.450	50.150	5.50	5.35	7.25
18	11.860	10.200	50.150	5.50	5.35	7.25
20	11.925	10.225	50.150	5.50	5.35	7.25
21	11.900	10.200	50.150	5.50	5.35	7.25
22	11.775	10.325	50.150	5.50	5.35	7.25
23	11.850	10.375	50.150	5.50	5.35	7.25
24	11.825	10.200	50.200	5.50	5.35	7.25
25	11.775	10.325	50.200	5.50	5.35	7.25
27	11.825	10.325	50.200	5.50	5.35	7.25
28	11.775	10.450	50.200	5.50	5.35	7.25
29	11.775	10.450	50.200	5.50	5.35	7.25
30	11.825	10.375	50.250	5.50	5.35	7.25
31	11.775	10.325	50.500	5.50	5.35	7.25
			AVERAGES FOR MONTH			
Jan.	11.819	10.257	50.154	5.500	5.350	7.250
Jan.			AVERAGES FOR WEEK			
1	11.790	10.305	50.100	5.500	5.350	7.250
8	11.817	10.167	50.100	5.500	5.350	7.250
15	11.808	10.167	50.100	5.500	5.350	7.250
22	11.854	10.308	50.150	5.500	5.350	7.250
29	11.804	10.354	50.192	5.500	5.350	7.250
Jan.			CALENDAR WEEK AVERAGES			
4	11.810	10.205	50.100	5.500	5.350	7.250
11	11.821	10.171	50.100	5.500	5.350	7.250
18	11.813	10.263	50.125	5.500	5.350	7.250
25	11.804	10.354	50.192	5.500	5.350	7.250

SILVER, GOLD AND STERLING EXCHANGE

Jan. 1941	Sterling Exchange "Checks" (Nominal)	Sterling Exchange "90-day demand"	Silver (c) New York	Silver London	Gold London	Gold (d) United States
1			Holiday			
2	402.000	(f)	34.750	23.2500	168s	$35.00
3	402.000	(f)	34.750	23.3750	168s	35.00
4	402.000	(f)	(e)	(e)	(e)	35.00
6	402.000	(f)	34.750	23.3750	168s	35.00
7	402.000	(f)	34.750	23.3750	168s	35.00
8	402.000	(f)	34.750	23.3125	168s	35.00
9	402.000	(f)	34.750	23.3750	168s	35.00
10	402.000	(f)	34.750	23.3125	168s	35.00
11	402.000	(f)	(e)	(e)	(e)	35.00
13	402.000	(f)	34.750	23.3125	168s	35.00
14	402.000	(f)	34.750	23.2500	168s	35.00
15	402.000	(f)	34.750	23.2500	168s	35.00
16	402.000	(f)	34.750	23.2500	168s	35.00
17	402.000	(f)	34.750	23.2500	168s	35.00
18	402.000	(f)	(e)	(e)	(e)	35.00
20	402.000	(f)	34.750	23.2500	168s	35.00
21	402.000	(f)	34.750	23.1875	168s	35.00
22	402.000	(f)	34.750	23.1875	168s	35.00
23	402.000	(f)	34.750	23.1875	168s	35.00
24	402.000	(f)	34.750	23.2500	168s	35.00
25	402.000	(f)	(e)	(e)	(e)	35.00
27	402.000	(f)	34.750	23.3125	168s	35.00
28	402.000	(f)	34.750	23.2500	168s	35.00
29	402.000	(f)	34.750	23.1875	168s	35.00
30	402.000	(f)	34.750	23.2500	168s	35.00
31	402.000	(f)	34.750	23.2500	168s	35.00
			AVERAGES FOR MONTH			
Jan.	402.000	.....	34.750	23.273	---	35.00
Jan.			AVERAGES FOR WEEK			
1	402.000	.....	34.750	.....	....	.....
8	402.000	.....	34.750	.....	....	.....
15	402.000	.....	34.750	.....	....	.....
22	402.000	.....	34.750	.....	....	.....
29	402.000	.....	34.750	.....	....	.....

Calendar week averages, New York Silver: Jan. 4th, 34.750; 11th, 34.750; 18th, 34.750; 25th, 34.750.
(e) Not quoted (Saturday). (f) No quotation.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the European War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. To arrive at the f.o.b. refinery quotations deduct .05 from the f.a.s. basis for lighterage.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade Zinc delivered in the East and Middle West in nearly all instances command a premium of 1c per pound over the current market for Prime Western but not less than 1c over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c per troy ounce. Handy & Harman's quotation on newly-mined domestic silver, 999 fine was 70⅝c throughout January.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1941 Jan.	Copper Standard Spot	Copper Standard 3 months	Copper Electro Bid	Tin Standard Spot	Tin Standard 3 months	Lead Spot Buyers	Lead Spot Sellers	Lead 3 months Buyers	Lead 3 months Sellers	Zinc Spot Buyers	Zinc Spot Sellers	Zinc 3 months Buyers	Zinc 3 months Sellers
1						Holiday							
2	Not quoted			256.5000	259.7500								
3	"	"	"	256.5000	259.2500								
6	"	"	"	256.7500	259.7500								
7	"	"	"	256.7500	259.7500								
8	"	"	"	256.5000	259.7500								
9	"	"	"	256.7500	259.7500								
10	"	"	"	257.0000	259.7500								
13	"	"	"	256.7500	259.5000								
14	"	"	"	256.7500	259.5000								
15	"	"	"	256.7500	259.2500								
16	"	"	"	256.7500	259.0000								
17	"	"	"	257.5000	258.7500								
20	"	"	"	257.2500	258.5000								
21	"	"	"	257.0000	257.7500								
22	"	"	"	256.2500	257.2500								
23	"	"	"	256.0000	257.2500								
24	"	"	"	256.2500	257.2500								
27	"	"	"	256.7500	257.2500								
28	"	"	"	257.0000	258.0000								
29	"	"	"	256.5000	257.5000								
30	"	"	"	256.0000	257.2500								
31	"	"	"	256.0000	257.7500								
Average for month				256.648									

Prices for tin are the official prices of the London Metal Exchange, in long tons (2240 lb.) Trading in other metals remained suspended.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(Feb. 1, 1941)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	17c.
Antimony, domestic, spot, lb	14.00c.
Bismuth, ton lots, lb	$1.25
Cadmium, commercial sticks, lb	80c.
Calcium, lb., ton lots 97 @ 98 per cent	Nominal
Chromium, 97 per cent grade, lb	89c.
Cobalt, 97 to 99 per cent, per lb	$1.50
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	27c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$36.00
Quicksilver, flask of 76 lb., 100 flasks or more	$167.00
Radium, mg. radium content	$25.00@$30.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$10.00
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 48 @ 50% Cr_2O_3 c.i.f. Atl. ports, long ton	(b)$34.00@$36.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$4.75
Mesabi bessemer	$4.60
Old Range non-bessemer	$4.60
Mesabi, non-bessemer	$4.45
Lead (Galena) 80 per cent, Joplin, Mo., ton	$64.54
Manganese Ore, (foreign) c.i.f. U.S. ports, long ton unit of Mn:	
52 @ 55 per cent	(b) 56c.
50 @ 52 per cent	(b) 55c.
46 @ 48 per cent	(b) 50@51c.
Molybdenum Ore, 90%, per lb. of MoS_2, f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	(b) $24.00
Domestic, 65 per cent and upward	(a) $23.50
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$48.00

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3½c.
Cobalt Oxide, 70 @ 71 per cent, lb	$1.84
Copper Sulphate, 100 lb	$4.75
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.42
Sodium Sulphate, bulk ton	$17.00@$18.00

ALLOYS

Beryllium Copper, master alloy, 2.5 to 3 per cent Be. per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, per pound of Cr contained	11c.
Ferromanganese, 78 @ 82 per cent, gross ton	$120.00
Ferromolybdenum 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 percent, gross ton	$74.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.80@$2.00
Ferrovanadium, per lb. of V, delivered	$2.70@$2.90

NON-METALLIC MINERALS

Asbestos, f.o.b. mines (U.S. funds), ton:	
Canadian (Quebec)	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$45
Shorts	$13@$17.50
Vermont	
Shingle stock	$57
Paper stock	$40
Cement stock	$25
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$6.50
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$7.00@$8.00
Domestic, abrasive, 80 @ 84 per cent	$14.00
Dalmatian, 50 @ 55 per cent	Nominal
French, 56 @ 59 per cent	Nominal
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$14.50
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$20.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00
Dead-burned, f.o.b. Washington	$22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1¼ x 2 in.	45@60c.
2 x 2 in.	60@80c.
3 x 3 in.	$1.25@$1.50
3 x 4 in.	$1.50@$1.75
3 x 5 in.	$1.75@$2.25
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12c.
Silica, in bags, 325 mesh, ton	$20.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.50@$10.50
Vermont, extra white, 200 mesh	$9.50@$10.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$24.50
Basic	$23.50
No. 2 Foundry	$24.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$34.00
Structural shapes, 100 lb.	$2.10
Bars, 100 lb.	$2.15

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1940	1941	1940	1941	1940	1941
January	34.750	34.750	21.892	23.273	395.442	(a) 402.000
February	34.750	.....	20.935	.....	395.652	.....
March	34.750	.....	20.763	.....	375.212	.....
April	34.750	.....	20.713	.....	351.817	.....
May	34.949	.....	21.878	.....	326.452	.....
June	34.825	.....	22.688	.....	359.560	.....
July	34.750	.....	22.095	.....	379.750	.....
August	34.750	.....	23.261	.....	396.889	.....
September	34.750	.....	23.446	.....	401.646	.....
October	34.750	.....	23.451	.....	401.692	.....
November	34.750	.....	23.238	.....	401.783	.....
December	34.750	.....	23.015	.....	402.000	.....
Year	34.773	.....	22.281	.....	382.325	.....

New York quotations for silver other than newly-minded domestic, cents per ounce troy, 999 fine, London pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents. (a) Nominal.

COPPER

	F.O.B. Refinery, Electrolytic			
	Domestic		Export	
	1940	1941	1940	1941
January	11.954	11.819	11.999	10.257
February	11.148	.....	11.471	.....
March	11.160	.....	11.407	.....
April	11.087	.....	11.258	.....
May	11.079	.....	11.191	.....
June	11.128	.....	11.216	.....
July	10.564	.....	10.189	.....
August	10.708	.....	9.851	.....
September	11.296	.....	9.849	.....
October	11.826	.....	10.436	.....
November	11.800	.....	10.084	.....
December	11.802	.....	10.293	.....
Year	11.296	.....	10.770	.....

New York quotations, cents per pound.

LEAD

	New York		St. Louis	
	1940	1941	1940	1941
January	5.471	5.500	5.321	5.350
February	5.076	.....	4.926	.....
March	5.192	.....	5.042	.....
April	5.071	.....	4.921	.....
May	5.015	.....	4.865	.....
June	5.000	.....	4.850	.....
July	5.000	.....	4.850	.....
August	4.854	.....	4.704	.....
September	4.929	.....	4.779	.....
October	5.308	.....	5.158	.....
November	5.726	.....	5.578	.....
December	5.500	.....	5.350	.....
Year	5.179	.....	5.029	.....

New York and St. Louis quotations, cents per pound.

TIN

	Straits New York		Standard, Spot London	
	1940	1941	1940	1941
January	46.707	50.154	240.716	256.648
February	45.851	.....	242.833	.....
March	47.079	.....	251.711	.....
April	46.815	.....	252.080	.....
May	51.570	.....	264.098	.....
June	54.618	.....	273.438	.....
July	51.591	.....	265.592	.....
August	51.176	.....	262.455	.....
September	50.348	.....	251.024	.....
October	51.490	.....	257.946	.....
November	50.577	.....	258.214	.....
December	50.101	.....	256.988	.....
Year	49.827	.....	256.425	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		
	1939	1940	1941
January	4.500	5.644	7.250
February	4.500	5.534	.....
March	4.500	5.750	.....
April	4.500	5.750	.....
May	4.500	5.803	.....
June	4.500	6.235	.....
July	4.516	6.250	.....
August	4.719	6.389	.....
September	6.104	6.920	.....
October	6.500	7.250	.....
November	6.500	7.250	.....
December	5.980	7.250	.....
Year	5.110	6.335	.....

St. Louis quotations, Prime Western, cents per pound.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1940 (a)	1941 (a)	1940	1941
January	79.038	80.000	20.000	17.000
February	80.000	.....	20.000	.....
March	80.000	.....	19.769	.....
April	80.000	.....	19.000	.....
May	80.000	.....	19.000	.....
June	80.000	.....	19.000	.....
July	80.000	.....	19.000	.....
August	80.000	.....	18.000	.....
September	80.000	.....	18.000	.....
October	80.000	.....	18.000	.....
November	80.000	.....	17.522	.....
December	80.000	.....	17.000	.....
Year	79.920	.....	18.691	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound. (a) Producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1940	1941	1940	1941	1940	1941
January	14.000	14.000	156.962	165.846	40.000	36.000
February	14.000	.....	178.000	.....	40.000	.....
March	14.000	.....	180.921	.....	40.000	.....
April	14.000	.....	173.538	.....	38.923	.....
May	14.000	.....	181.538	.....	38.000	.....
June	14.000	.....	197.360	.....	38.000	.....
July	14.000	.....	194.423	.....	38.000	.....
August	14.000	.....	184.111	.....	38.000	.....
September	14.000	.....	173.333	.....	36.167	.....
October	14.000	.....	168.846	.....	36.000	.....
November	14.000	.....	168.391	.....	36.000	.....
December	14.000	.....	164.960	.....	36.000	.....
Year	14.000	.....	176.865	.....	37.924	.....

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk 13.415 for January. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum, dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1940	1941	1940	1941	1940	1941
January	23.50	24.50	22.50	23.50	23.00	24.000
February	23.50	.....	22.50	.....	23.00	.....
March	23.50	.....	22.50	.....	23.00	.....
April	23.50	.....	22.50	.....	23.00	.....
May	23.50	.....	22.50	.....	23.00	.....
June	23.50	.....	22.50	.....	23.00	.....
July	23.50	.....	22.50	.....	23.00	.....
August	23.50	.....	22.50	.....	23.00	.....
September	23.50	.....	22.50	.....	23.00	.....
October	23.50	.....	22.50	.....	23.00	.....
November	23.50	.....	22.50	.....	23.00	.....
December	23.50	.....	22.50	.....	23.00	.....
Year	23.500	.....	22.500	.....	23.000	.....

Iron, dollars per long ton. F.o.b. Mahoning and Chenango Valley furnaces

PERSONAL ITEMS

C. W. Allen, Ishpeming, Mich., will have charge of the new Section 2 mine being opened at Ishpeming, Mich., for The Cleveland-Cliffs Iron Co.

William A. McCurdy, superintendent for the Virginia-Eveleth district Oliver Iron Mining Co., retired of Jan. 31 after 39 years of service.

F. Schruhm has been appointed mine manager of Hogs Reef Mining Co., Avoca, Victoria, in place of **T. Leonard,** who has resigned.

Frank Cash, district engineer in Birmingham for the U. S. Bureau of Mines, has been transferred to the Duluth, Minn. office in the same capacity.

Joseph C. Kieffer, formerly at Wallace, Idaho, is mill superintendent at the Duquesne mine of Callahan Zinc-Lead Co., Nogales, Ariz.

Otis M. Clarke, Jr., has returned to the United States from Mina El Oro, Chilecito, La Rioja, Argentina, and can be reached at Box 84, Grafton, Va.

R. M. Marshall, vice president of Woodward Iron Co. since 1935, has resigned to become executive vice president of Pittsburgh Coke & Iron Co.

Dominic P. Negri, Arizona mining engineer, has returned to the United States after six years' professional work in Northern Rhodesia.

Max. H. Barber, vice president of The Cleveland-Cliffs Iron Co., left Hibbing on Jan. 2 and is now located at Cleveland, Ohio, in the executive offices of this company.

Arnold H. Miller, executive vice president of Certain-teed Products Corporation, of New York City, has returned from Death Valley, California, on examination work on gypsum properties.

R. L. Faulkner, assistant geologist for Cerro de Pasco Copper Corporation, Lima, Peru, has returned to the United States and is at 1426 21st St., N. W., Washington, D. C.

Harry H. Moore has resigned as a director of Anaconda Copper Mining Company and **Maurice Newton,** of Hallgarten & Co., has been elected a director in his place.

Marshall S. Walker, of Walker & Whyte, Inc., assayers, has been appointed by President Roosevelt to serve on the United States Assay Commission, which met in Philadelphia, Pa., Feb. 12, 1941.

J. H. Farrel, geologist until recently with the Standard Cyaniding Company near Rye Patch, Pershing County, Nev., has joined the staff of the Twin Buttes Syndicate, which is developing a new property in western Pershing County.

Augustin Leon Jean Queneau, of Peapack, N. J., metallurgist with United States Steel Corporation, was on Jan. 21 awarded the Columbia Lion, by the Columbia University Club of Essex County, New Jersey.

Frank Ayer, who for nearly eight years has been general manager of Roan Antelope Copper Mines, Ltd., and Mufulira Copper Mines, Ltd., Northern Rhodesia, arrived in New York Dec. 20 after a 30-day voyage from Capetown on the freighter "Ohioan," of the American South African Line. He comprised 50 percent of the passenger list and

FRANK AYER

found life on the freighter particularly enjoyable and pleasant. Mr. Ayer has been made consulting engineer for Roan Antelope and Mufulira, with offices in the United States during the war. Although he found it difficult to leave friends in Northern Rhodesia with whom he had been closely associated, he is nevertheless glad to reunite his family and to renew old acquaintances in the United States and Mexico, where he had previously managed properties of the Phelps Dodge Corporation.

Hugh W. Coke, until recently metallurgist at the concentrator of Alaska Juneau Gold Mining Co., Juneau, Alaska, has been appointed superintendent of the Atolia Mining Co., Atolia, Calif. He succeeds **L. E. Putnam,** resigned.

Herbert W. Gartrell, professor of mining and metallurgy at the University of Adelaide, South Australia, has been elected president of the Australasian Institute of Mining and Metallurgy for 1941.

J. C. Kinnear, manager for New Cornelia Copper Corporation, a Kennecott subsidiary, has been elected president of the Nevada Mine Operators Association. Other officers chosen were **H. A. Johnson,** first vice president; **E. A. Julian,** second vice president; and **Henry M. Rives,** of Reno, secretary.

John H. Eggers has left the Bondurant Mine, at Coulterville, Calif., and is now superintendent of the Abbott mine, near Williams, Calif. This mine is an old quicksilver producer which is being reopened and rehabilitated.

Walter S. Weeks has been elected chairman of the San Francisco section of the A.I.M.E. for 1941. **Henry W. Gould** is vice chairman; **Gordon I. Gould,** secretary-treasurer; and **Robert Hawxhurst, Jr., Charles White Merrill, Henry C. Carlisle,** and **W. Sprott Boyd** have been made directors.

J. Murray Riddell, as of Jan. 1, joined the staff of the E. J. Longyear Company, Minneapolis, Minn., as manager of its mining division. He will supervise the company's contract shaft sinking operations and act as consulting mining engineer.

J. S. Anderson has been appointed lecturer and investigator in secondary metallurgy at the South Australian School of Mines and Industries, Adelaide, S. A. For the past two years he has been lecturer in secondary metallurgy at the Melbourne Technical College.

E. B. Dow has been appointed mine manager of Eldorado Tennant Creek, Ltd., Tennant Creek, Northern Australia. Mr. Dow was formerly assistant manager of the Central mine, Broken Hill. He succeeds **H. Maitland Thomas,** who has left Tennant Creek to enlist in the Royal Australian Air Force.

John A. Burgess, general manager, Carson Hill Gold Mining Corporation, Melones, Calif., was recently re-elected president of the Mother Lode Mining Association. Other officers elected include **P. R. Bradley, Jr.,** manager, Pacific Mining Co., as vice president, and **W. D. Manning,** Argonaut Mining Co., Ltd., as secretary-treasurer.

Walter F. Meckel, metallurgist for Compania Minera Unificada del Cerro de Potosi and of the Hochschild properties in general in Bolivia, has terminated a three months' vacation in the United States and sailed for Bolivia on February 14. Mr. Meckel has been in South America for the past ten years.

Robert W. Wilson has resigned as manager of Empress Minera Chilcani in Bolivia, and has returned to the United States to take a position with Certain-teed Products Corporation. His present address is 2771 Delaware Ave., Kenmore, N. Y. After about three months in the corporation's Buffalo office, he expects to be sent to one of its mines.

Russell C. Fish, chief engineer of M. A. Hanna Company mines in Michigan, recently became superintendent of the company operations in northern Minnesota. His office is in Hibbing. Other appointments recently announced by the company are the advancement of **S. E. Quayle,** former superintendent of the Bates, Rogers & Zimmerman mines, to general superintendent of the Michigan district, and **Walter E. Dewald,** mining engineer, to chief engineer in the Michigan district.

L. S. Breckon, geologist for the Utah Copper Company at Bingham Canyon, Utah, has been reelected president and managing director of the Rip Van Winkle Mining Company, operating the old Rip Van Winkle lead-zinc-silver mine and 100-ton selective flotation mill in the

Merrimac district, 36 miles north of Elko, Nev.

T. W. Bingay was recently re-elected president of the Mining Association of British Columbia. Other officers for the ensuing year include vice presidents **H. P. Wilson** and **F. W. Guernsey**, and secretary, **H. Mortimer-Lamb.**

Gomer P. Jones, formerly managing director of the Nickel Plate mine, was recently elected president of the British Columbia Chamber of Mines for the forthcoming year. Vice presidents are **Dr. Victor Dolmage** and **A. E. Jukes. F. P. Archibald** is honorary treasurer and **Frank E. Woodside** continues in the position of manager.

A. C. Harding has been transferred from the Osage, Wyo., plant of the National Lead Co., to El Portal, Calif., where he is mine foreman of the company's barytes property. In Wyoming he was acting superintendent during the past summer at a plant processing bentonite.

Ralph Keeler is on active duty as a first lieutenant, M.I.D., at Fort Santiago, Headquarters, Philippine Department, Manila. He has been identified with the mining industry of the Islands for six years, publishing the "Philippine Mining Yearbook," and acting as correspondent for *E.&M.J.*

Grant B. Shipley, consulting engineer, formerly chief engineer of Allis-Chalmers mining department at Milwaukee, and later with American Nickel, American Mond Nikel and International Nickel of Canada, and who has long been identified with the development of processes for wood preservation, has sold his interest in the Wood Preserving Corporation, of Pittsburgh, to the Koppers Co., with which he is still associated as consultant.

C. W. Nicolson, retiring chairman of the Tri-State section of the A.I.M.E., was re-elected chairman for 1941 at a meeting of the directors early in January. Other officers named were **H. G. Weidman,** vice chairman, and **Evan Just,** secretary-treasurer. Mr. Just is also secretary of the Tri-State Zinc & Lead Ore Producers Association. The new directors, elected by mail ballot, are **G. E. Abernathy, F. J. Cuddeback, C. F. Dike** and **J. P. Lyden, R. K. Stroup, C. F. Williams** and **Mr. Weidman.**

James Hopkins is chief mining engineer for Luzon Stevedoring Co., the largest producer of manganese in the Philippines. Operations of this company are on the Islands of Siquijor and Busuanga. Mr. Hopkins is stationed at Siquijor Island in direct charge of these operations, where 2,000 tons are being produced monthly. The milling plant on Siquijor Island is now in process of being enlarged and early in February, 1941, production from this island alone will be increased to approximately 4,000 tons manganese monthly. All production is being shipped to United States.

John Van Nostrand Dorr, president of The Dorr Company, received the Perkin Medal for 1941 at a joint meeting of chemical and chemical engineering societies in New York on Jan. 10. The award was established in 1906 in honor of the late Sir William H. Perkin, and is awarded annually for outstanding achievement in the application of chemistry to industry. Responding to the presentation of the medal, Mr. Dorr spoke on 'The Engineer and His Responsibility to the World of Today and Tomorrow."

Sherwin F. Kelly has recently been appointed Walker-Ames lecturer in geophysics at the University of Washington, in Seattle. This is a visiting lectureship in the course of which Mr. Kelly gave ten lectures on general and exploration geophysics. Three of the lectures on exploration geophysics were given at the annual Mining Institute meeting at the College of Mines, University of Washington, in cooperation with the North Pacific Section of the A.I.M.E.

Three of the four special Bureau of Mines engineers to be sent to South America to give technical advice in expanding the output of strategic materials from Latin America were appointed during January. **William F. Jahn** has been sent to Argentina, **Joseph R. Guiteras** to Chile, and **William O. Vanderburg** to Peru. The engineers are assigned to American embassies and legations to assist in solving technical problems involving expanding output from known sources of supply.

Alva H. Gunnell, consulting engineer for Newalpitt Corporation, has returned to his headquarters office, 221 South Vassar Ave., Albuquerque, N. M., after several months of field work which included a study of the strategic minerals resources of New Mexico, with special attention to manganese and tungsten, and the preparation of the maps, reports and engineering data used at Washington by Newalpitt in negotiating its contract with the U. S. Government which provides for the production, purchase and stockpiling in New Mexico of 180,000 tons of specification grade manganese ores and concentrates. Examination was also made of recent discoveries of sheelite, which give promise of being the first deposits of tungsten ore of commercial importance reported in New Mexico.

▼ ▼ ▼

OBITUARY

William S. Gage, a New York mining engineer, died at Twin Bridges, Mont., on Feb. 4, at the age of 75.

W. W. Fleming, who was district mining supervisor of the McAlester, Okla., district of the Geological Survey, died Dec. 23, 1940.

Paul E. Fernald, southern Arizona mining and civil engineer, died on Jan. 8 at Fort Lyon, Colorado, at the age of 55.

Miss Olive C. Postley, a geologist long on the staff of the United States Geological Survey, died on Jan. 14 in Washington, D. C.

Fred A. Jordan, geologist in charge of Youngstown Sheet & Tube Co. mining properties, died in Youngstown, Ohio, on Dec. 14.

Joseph Evan Edmunds, 75, pioneer Utah mining man, died at Salt Lake City on Dec. 25. Mr. Edmunds was identified with much of the early development in the Bingham district.

A. F. Bingenheimer, director and treasurer of Northwest Mining Association, died in Spokane, Wash., on Dec. 30, aged 66. He was general manager of the Golden Rod Mining Company of Spokane.

William Trefor Morgan, chief metallurgist for the Taylor Instrument Companies at Rochester, N. Y., died recently at the age of 45. Mr. Morgan had been with the Companies since 1929. He was a member of the A.I.M.E.

Frank E. Holmes, prominent as a mining and mechanical engineer in California, and for the last six years connected with the building of the 200-in. telescope at Palomar Mountain, died in Pasadena, Calif., on Dec. 23, at the age of 52.

Frederick C. Alsdorf, a former mine operator in Gilpin County, Calif., and well known in the mining districts of Utah, Idaho, and Arizona, and who found and developed the famous Miami Copper mine, in Arizona, died on Dec. 14 last in California. Mr. Alsdorf was 69.

Duncan MacVichie, 83-year old mining engineer and railroad builder, died Jan. 18 in Salt Lake City. If he had lived, Mr. MacVichie would have been given the Legion of Honor Medal at the annual A.I.M.E. banquet on Feb. 19, for he had been a member of the organization for 50 years.

H. Robinson Plate, well-known consulting engineer, died in San Francisco on Jan. 4, aged 63. He was a graduate of Stanford University, and at one time represented the Guggenheim Exploration Company in Colorado. In recent years Mr. Plate held the managership of Spring Hill Mine, Inc., Grass Valley, Calif., and at the time of his death was associated with Sonoma Quicksilver Mines Co.

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A LETTER

"Grinding Pebbles and Tube-mill Liners"

The Editor:

IN YOUR ISSUE for January, 1941, page 114, you published an extract from Information Circular 7139, of the U. S. Bureau of Mines, which states that "King Solomon Gold Mines, Black Bear (or Crocker Bldg., San Francisco)" is a producer and seller of pebbles and silex liners for grinding mills. The King Solomon Mines Company, to which this no doubt refers, has never produced pebbles for sale. For about nine years it collected pebbles from a river bed for its own use. Operations at the mine were discontinued on Dec. 5, 1940, and the company was liquidated. We shall appreciate your courtesy in making this correction for the information of the mining industry.

WILBUR H. GRANT,
Consulting Manager,
King Solomon Mines Co.
San Francisco, Calif.

What Metal Statistics Show

OBSERVERS view labor's dilemma in the Lake Superior copper district, in a C.I.O. strike at the Quincy copper mine on Feb. 11, for a higher price of copper so miners will receive a wage increase, as a novel departure from the orderly price structure that copper producers in cooperation with government officials, have so far maintained in the national defense program. The industry believes the so-called small marginal producers in Michigan and in the West are exploiting orebodies as efficiently as present conditions of higher taxes and wages permit under 12c. copper. It is also pointed out that small producers also would find themselves in a dilemma when faced with strikes for higher wages in the face of government action in buying 200,000 tons of copper from Latin American countries to be supplied to domestic consumers under the virtual ceiling of 12c. copper. Tension among consumers has eased recently with the government assurance of ample copper supplies from foreign sources.

For disposal of this foreign copper, R. R. Eckert, secretary of the United States Copper Association, has been made chairman of a committee to receive applications and make recommendations for the allocation of Latin American copper acquired by the Metals Reserve Co. Other members of this committee are T. E. Veltfort, manager of Copper & Brass Research Association; W. J. Donald, National Electric Manufacturers' Association; John A. Church, Office of Production Management; and Donald Wallace, of the Council of National Defense.

Edward R. Stettinius, Jr., director of the priorities division of the Office of Production Management, Washington, D. C., on Feb. 1 confirmed the appointment of priorities committees for nonferrous metals and minerals. Those named to serve are:

Non-Ferrous Metals and Minerals—Irwin H. Cornell, vice-president St. Joseph Lead Co., representing producers; H. L. Erlicher, General Electric Co., consumers; Colonel A. J. Lyon, Army; and Lieut. Commander D. N. Logan, Navy.

Aluminum and Magnesium—Eugene J. Barney, Frigidaire Division, General Motors Sales Corporation, representing consumers; Colonel W. R. Slaughter, Army; and Commander W. H. von Dreels, Navy.

The figures of the Copper Institute, duty-free metal only, for December, 1940, and January, 1941, in tons, follow:

	Dec.	Jan.
Production:		
Crude (a)	(c)85,135	83,379
Refined	97,035	93,327
Deliveries:		
Domestic	112,671	119,736
Export	10	22
Totals	112,681	119,758
Stock at end, refined (b)	142,772	116,341

(a) Mine or smelter production or shipments, plus custom intake, including scrap. (b) At refineries, on consignment, and in Commodity Exchange warehouses, but not including stocks at consumers' plants or warehouses. (c) Corrected.

▶LEAD—Stocks of lead refined in the United States amounted to 40,926 tons at the end of December, an increase of 5,135 tons compared with the total in producers' hands a month previous.

The record for the years 1939 and 1940, in tons, according to the American Bureau of Metal Statistics, follows:

	1939	1940
Stock at beginning	115,902	58,777
Production:		
From domestic ore	462,213	480,894
Foreign and secondary	35,778	104,586
Totals	497,991	585,480
Domestic shipments	555,074	603,143
Stock at end	58,777	40,926

The figures for November and December, in tons, compare as follows:

	Nov.	Dec.
Stock at beginning	35,386	35,791
Production:		
From domestic ore	45,089	47,208
Foreign and secondary	12,837	14,698
Totals	57,926	61,906
Domestic shipments	57,510	56,755
Stock at end	35,791	40,926

▶ZINC—The December and January statistics of the American Zinc Institute, covering all grades, are summarized as follows in tons:

	Dec.	Jan.
Stock at beginning	18,386	12,884
Production	59,883	59,156
Production, daily rate	1,912	1,908
Shipments	65,385	63,272
Stock at end	12,884	8,768
Unfilled orders	125,132	121,026

(a) There were no exports of domestic slab zinc during the months of December and January.

Figures on operations of the Prime Western division alone, for January, 1941, in tons, follow:

	Production	Shipments	Stock At End
January	25,362	28,209	3,436

▶MAGNESIUM—Production of primary magnesium in 1940 totaled 6,250 short tons, the largest output in the history of the domestic industry, the Bureau of Mines reports. Output last year was 87 per cent above the previous peak of 3,350 tons attained in 1939.

The Dow Chemical Company, at present the sole producer of metallic magnesium in this country, expects to produce 15,000 tons of metal in 1941. In February, 1940, the company doubled capacity of its plant at Midland, Mich., and in January, 1941, production was begun at a newly constructed plant at Freeport, Tex. The first-named plant utilizes magnesium chloride derived from underground brine and the new plant in Texas employs sea water as the raw material.

Henry Kaiser Company, Oakland, Calif., plans to build a magnesium recovery plant at Cupertino, Calif., with government funds, to produce about 12,000 tons of magnesium metal a year. Nevada magnesite will be used.

▶CADMIUM—Production of metallic cadmium in 1940 amounted to 6,101,000 lb., compared with 4,411,530 lb. in 1939, according to a preliminary estimate by the Bureau of Mines. Production and sales were near in balance during the last year. Sales in 1940 totaled 6,113,000 lb., against 5,190,273 lb. in 1939. Production and sales figures for 1939 have been revised.

Imports of metallic cadmium dropped from 309,874 lb. in 1939 to only 27,491 lb. in the first eleven months of 1940. Because of the war, imports from Europe have virtually ceased.

The cadmium content of compounds produced in 1940 is estimated at 785,000 lb., an increase of 16 percent over 1939. Cadmium compounds produced included cadmium lithopone, cadmium oxide, cadmium sulphide, cadmium sulphate, and cadmium hydrate.

▶CHROME ORE—Imports of chrome ore for domestic consumption during November, according to the Bureau of Foreign and Domestic Commerce:

From:	Gross Weight Tons	Chromic Oxide Content Tons
Canada	48	24
Philippines	10,373	5,014
Turkey	9,900	4,752
French Oceania	7,711	4,395
Union of S. Africa	20,228	9,159
Other Br. S. Africa	22,054	10,772
Totals	70,314	34,116

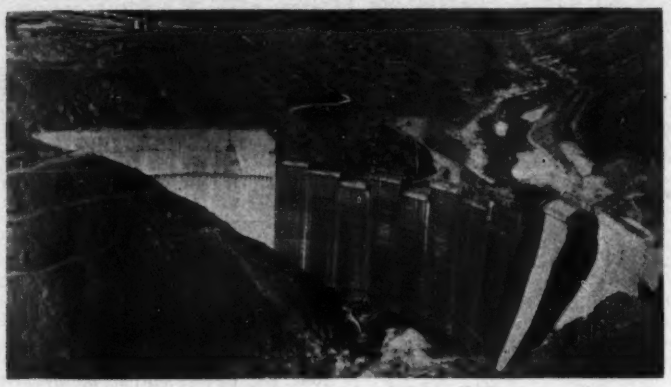
Imports of chrome ore during the first eleven months of 1940 totaled 582,399 tons, containing 266,316 tons of chromic oxide, valued at $7,702,433.

E & M J Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922–3–4)

1929	110.33	1934	69.59
1930	82.87	1935	74.66
1931	60.20	1936	73.45
1932	48.26	1937	90.86
1933	59.79	1938	73.67
1939	77.71	1940	79.22

	1939	1940	1941
January	77.12	80.85	82.48
February	76.89	77.23	....
March	77.09	77.94	....
April	74.79	77.19	....
May	73.61	77.68	....
June	73.17	78.85	....
July	71.95	76.72	....
August	73.88	76.71	....
September	83.07	79.40	....
October	84.25	82.40	....
November	83.80	81.14	....
December	82.89	82.42	....



Completion of the Upper Narrows debris dam near Smartville, on the Yuba River, California, will encourage more hydraulic mining in 1941. The Sacramento Valley Power Co. also plans to utilize water stored behind this dam for power-generating purposes

CALIFORNIA

Upper Narrows Debris Dam Completed

Application for hydraulic mining license can now be made to California Debris Commission—Two new orebodies reported discovered at Alhambra gold mine

▶ Revival of large-scale hydraulic mining operations, virtually dormant since 1884, has been brought a step nearer with the completion early in January of the Upper Narrows débris dam near Smartville, Yuba County. This dam is the second and largest to be built during the past two years of four débris dams scheduled for construction at strategic points in central California. The Upper Narrows dam has a capacity of some 118,000,000 cu-yd., and will serve numerour hydraulic mines in Yuba, Nevada, and Sierra counties. Applications for license to mine by hydraulic process and store débris in the newly created reservoir can now be made to the California Débris Commission in Sacramento. Work on the remaining two dams, the Dog Bar, on the Bear River, and the Ruck-A-Chucky, on the Middle Fork of the American River, is confined to search for and preparation of appropriate sites.

▶ The 7-cu.ft. dredge under construction at the Saeltzer ranch, on the north bank of Clear Creek near Redding, Shasta County, by Yuba Manufacturing Co. for the Thurman Gold Dredging Co., of San Francisco, has been completed, and is reported to be working steadily. Charles H. Thurman, with offices at 960 Russ Building, San Francisco, is president of the company.

▶ Discovery of two new orebodies in the noted Alhambra mine, near Kelsey, El Dorado County, has been announced by officials of Alhambra-Shumway Mining Co., the owners. It is the result of a comprehensive development program started last spring, involving deepening of the main shaft to 440 ft., lateral work on the 225 and 400 levels, and diamond drilling. Nearly $1,000,000 was produced in 1939 from a high-grade orebody on the 225 level. A small tonnage of development ore is currently handled at the 35-ton Straub mill available at the property. Ray Henricksen is superintendent.

▶ Dredging operations have been increased in El Dorado County by the addition of two new units to the fleet of draglines active in that area. J. Butler and associates have completed the assembly of a dragline dredge on placer ground near Kelsey, El Dorado County, owned by Russel J. Wilson, of Placerville, and Eclipse Placer Engineering Co. has placed in operation a new unit on the Stone property, near Placerville.

▶ Preliminary work has been completed at the Relief Hill hydraulic mine, in Nevada County, owned by Western Gold, Inc., and operations are scheduled to start as soon as sufficient water is available. Tailings will be stored behind the Upper Narrows débris dam, just completed. C. E. Clark, of North Bloomfield, directs operations.

▶ Richter & Sons Co. have started dredging operations on the Middle Fork of the Yuba River below Freeman's Crossing bridge in Nevada County, following removal and reassembly of the dragline unit formerly handling gravels of the Nevada irrigation district at Scotts Flat.

▶ Construction of a 200-ton cyanide plant to treat a large tonnage of mill tailings is nearing completion at the Princeton mine, near Mount Bullion, Mariposa County. The project is operated by a syndicate controlled by J. Austin, Glenn Coburn, Thomas W. Murray and Bertle Stromeir.

▶ Preparations for sinking a new shaft to a depth of 300 ft. to explore territory believed to contain the extension of an orebody mined by former operators 200 ft. below the tunnel level are in progress at the Oregon Hill mine, near Placerville, El Dorado County, operated by the Oregon Hill Gold Mining Co., Inc., L. F. S. Holland, manager. Construction and development work completed in recent months includes erection of a new headframe, hoisting and compressor buildings, and some 600 ft. of lateral work underground.

ARIZONA

Gold Dredging Planned In Big Bug District

Arical Mines will exploit placer area near Mayer—Low-grade manganese ore in Artillery Peak section to be concentrated in pilot plant

▶ A floating dredge of the latest design is being constructed by the Arical Mines, of Mayer, to operate on the Gilker and Lawson placer properties in the Big Bug district. Pan-American jigs and a Titan amalgamator will be employed in recovering the gold. The excavating is done with 2¼-cu.yd. Lima dragline shovel. Gordon R. Kronkhite is president of the company and E. R. Mattson, of Prescott, is superintendent.

▶ The United States Bureau of Mines is driving a long tunnel and doing considerable diamond drilling on the low-grade manganese deposits in the Artillery Peak section of Mohave County near the Bill Williams River. This manganese de-

Operations by the Poverty Hill Mining Company near Strawberry Valley, Calif., involve the handling of slush-like gold-bearing gravel. An Allis-Chalmers HD 14 tractor equipped with a Moore bulldozer pushes the material into the stream of the monitor near the grizzly. About 1,000 cu.yd. of gravel are removed every 24 hrs.

Taking up the slack

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The proof is the way these batteries stand up in tunnel-driving operations, and the long years of trouble-free service they deliver for mine operators the country over. Dependability is one of the chief reasons why more Exide-Ironclads are used underground than all other batteries combined. Write for free booklet, "The Storage Battery Locomotive for Underground Haulage."

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The Clay orebody at the Morenci branch of the Phelps Dodge Corporation in Arizona is rapidly being prepared for production by the end of 1941. The illustration above shows a four-car train of Differential side-dump cars, with 40-cu.yd. level capacity, being loaded with copper ore

▶ ARIZONA

posit is known as one of the largest in the United States, and late reports indicate that results so far are satisfactory and are disclosing a tonnage in excess of the estimates made by the owners. A substantial tonnage will be used in pilot mills for experimental purposes to determine the best method of ore concentration.

▶ The Grand Prize gold mine, owned by Charles H. Neimeyer, of Florence, and situated about 32 miles east of that city, is under option to Chicago interests now installing equipment and preparing development and exploratory work. John Pytlik, of Chicago, is in charge of operations.

▶ Banner Mining Co. has acquired a group of claims adjoining the Polaris mine, 10 miles north of Clifton. A new shaft has been sunk 250 ft. and drifting in both directions is now underway. The Banner Mining Co.'s principal operations are near Lordsburg, N. M. H. I. Grimes, 1910 First National building, Oklahoma City, Okla., is president of the company.

▶ The Dover Copper Mining Co., operating a property 2 miles northwest of Morenci, is making regular shipments of gold-silver ore from the Tucky mine. A shipment of copper ore is also expected to be made, the ore coming from the same property. Gregg De Grazia, Box 878, Clifton, Ariz., and associates hold the property under lease.

▶ The Arizie Products Corporation, operating 9 miles southeast of Mammoth, in Pinal County, has increased the capacity of its mill by 10 tons an hour. The mill was built last spring to work on a diatomaceous earth deposit in the Galiuro Mountains and has been handling about 30 tons daily. The deposit is estimated to contain more than 2,000,000 tons. Marion G. Staley, of Oracle, Ariz., is general manager.

▶ A Kansas City syndicate consisting of J. B. Milstead, N. F. Van Seyoc, and Horace Campbell has taken over the Evahom property in the Mineral Park area 15 miles north of Kingman in the Cerbat Mountains. A large body of milling ore is reported available as well as a substantial amount of shipping ore. Brooks M. Dudley is in charge.

▶ Shipments of ore are being made from the Rico mine, 15 miles north of Kingman, on the east slope of the Cerbat Mountains, to the Producers, Inc., mill near Chloride. The mine is under lease and option to Ben Williams, of Kingman. Greeley Clack is owner of the property.

NEVADA

Getchell Mine Will Install Second Rotary Furnace

Two units required to treat increasing volume of sulphide ore—Gray Rock Mining Co. complete sinking shaft to 1,000-ft. level at Elkoro mine

▶ A second 7½x260-ft. rotary furnace, similar to that now in use, will soon be installed in the ore-roasting department of the 1,000-ton cyanide mill of the Getchell Mine, Inc., in the Potosi district, eastern Humboldt County. An increasing volume of sulphide ore, requiring a preliminary low-temperature roast before cyanidation, makes necessary the larger furnace capacity. With payment of the January dividend of 2½c., disbursements aggregated $1,342,500 in 26 payments since the first, in September 1938.

▶ By an order issued in the federal court for the southern district of New York, large properties, with mill and equipment, of the Austin Silver Mining Co., adjudged bankrupt over a year ago, were sold at public auction in New York on Jan. 23.

▶ At Silver City, in the Comstock district, the lately organized Gold Rock Mining Co. has developed a substantial tonnage of mill-grade ore in the Well-Emma and adjoining old patented mines, which it acquired recently together with the Trimble mill, long operated as a custom plant. The mill has been remodeled and equipped with additional flotation units. N. H. Getchell, vice-president and manager for the Getchell Mine, Inc., is president of the Gold Rock company.

▶ In the Jarbidge district, northern Elko County, a 3,400-ft. aerial tramway, extending from the main 1,800-ft. tunnel to the millsite of the old Bluster mine, has been repaired by the Crater Range Gold Mining Co. In the spring the company plans to reconstruct the partly dismantled 80-ton cyanide mill. E. R. Lund of Jarbridge is manager.

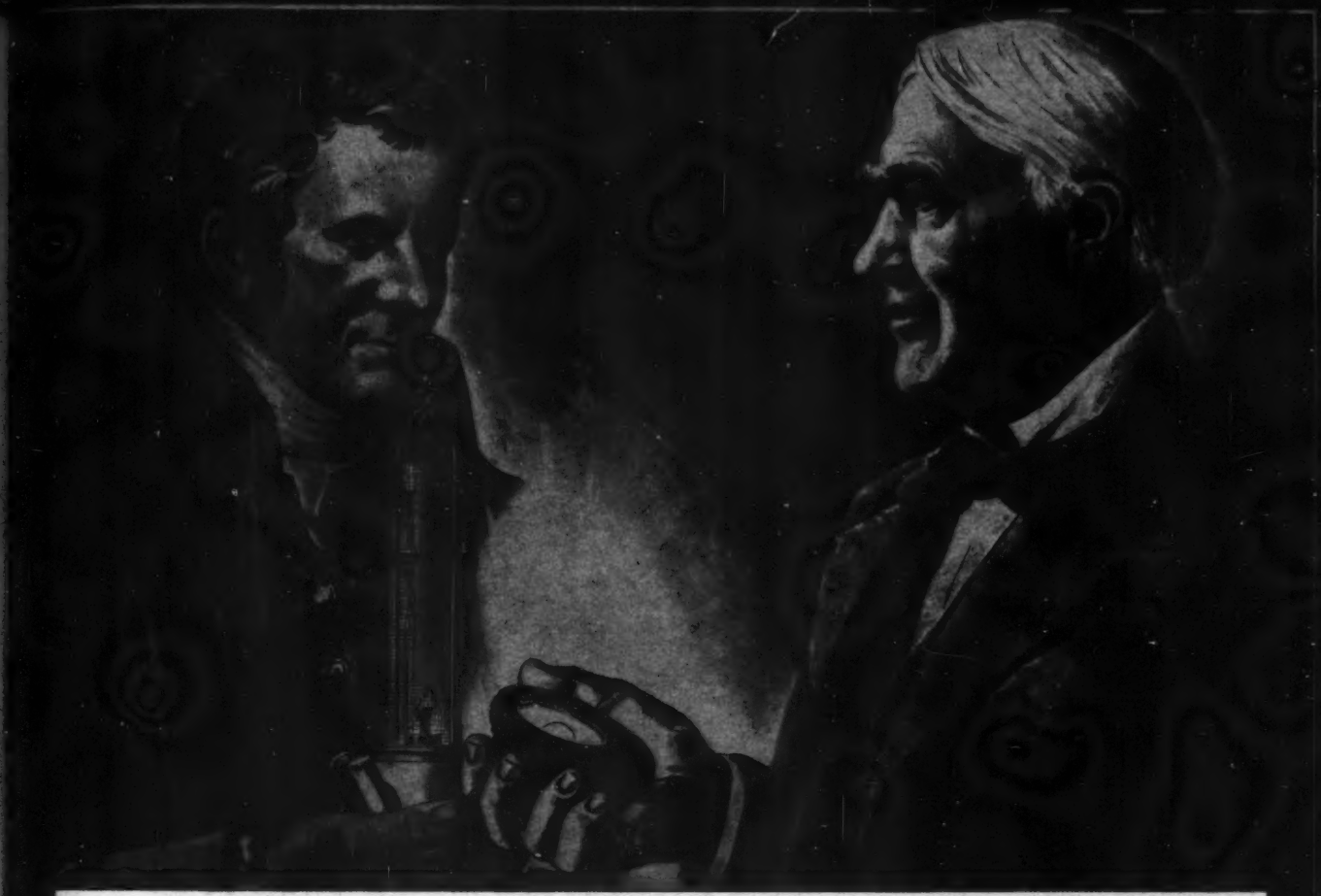
▶ The Gray Rock Mining Co., a Newmont subsidiary, has completed sinking a 1,000-ft. vertical shaft on the Elkoro mine. Ore or high grade is said to have been opened lately on the 1,000-ft. level. John Becker is manager at Jarbidge.

▶ Prospect drilling has been resumed under direction of U. S. Bureau of Mines engineers in a nickel-bearing area at the Key West mine, near Bunkerville, eastern Clark County, a contract having been awarded the Diamond Drill Construction Co. of Los Angeles. George Dodds was reported to be in charge.

▶ A tailing treatment plant operated for 12 years by the Bradshaw Syndicate, Inc., on some 2,000,000 tons of tailing from the long-dismantled 1,000-ton cyanide mill of the Goldfield Consolidated Mines Co., has completed the operation.

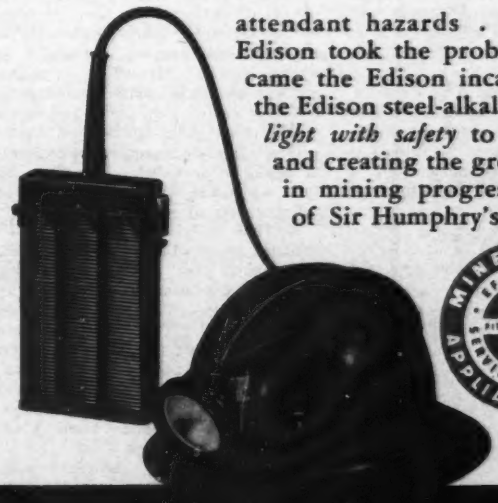
▶ Dayton Dredging Co., reputed to be a subsidiary of the California Gold Dredging Co., now has in operation on part of the townside of the old town of Dayton, on the Carson River in Lyon County, a Bucyrus-Monighan walking dragline unit and floating washing plant designed to handle upward of 10,000 cu-yd. of gravel per day, installed by the Bodinson Manufacturing Co. The dragline, weighing 850 tons, is equipped with 180-ft. boom and 14-cu.yd. bucket and is powered by a 650-hp. motor. Equipment of the washing plant includes a ball mill, trommel screens, 32 Pan-American jigs, and a 190-ft. stacker with 42-in. conveyor belt. G. M. Standifer, of San Francisco, is president, P. S. Crocker, manager, and Dan Avery, superintendent at Dayton.

▶ Further investigation of cinnabar deposits in the Bottle Creek district, in central Humboldt County, has been conducted by the U. S. Bureau of Mines, a reconnaissance having been conducted last year by the Geological Survey. Between the end of July and November 1940 the district production was from 15 to 20 percent of the total United States output of mercury, the Greenan Quicksilver, Inc., having produced 727 flasks in the three-months' period and the McAdoo mine furnace producing 100 flasks in one 24-hour period. Deepest point of production has been at the 80-ft. level of the Greenan shaft. A 4x48-ft. Gould rotary furnace is operated by the Greenan company, headed by J. O. Greenan, of Reno, a 30-ton Nichols-Herreshoff furnace on property of Dr. W. C. McAdoo, of Winnemucca, a 20-ton Cottrell furnace on the White Peak group, and retorts on the Neibuhr and Major properties.



"Sir Humphry Davy, meet Mr. Edison!"

Famed in the lore of mining is Sir Humphry Davy, who first found a safe and practical way to measure the danger-element in mine air. A grateful sovereign knighted the inventor of the Davy Lamp as one of the benefactors of his time • But miners still had to *see* by an open flame, with all its attendant hazards . . . until Thomas Edison took the problem in hand! Then came the Edison incandescent lamp and the Edison steel-alkaline battery, bringing *light with safety* to men underground, and creating the greatest single advance in mining progress since the advent of Sir Humphry's lamp.



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NEWS FROM Washington

By Special Correspondent

"BUSINESS AS USUAL" will no longer be considered a proper motto. The expansion of defense activities is definitely expected to pinch off some industrial activities normally considered important. Sacrifices of this sort are expected from the public and industry from now on.

The reason for this curtailment of other business activity is twofold. First, there must be greater speed on defense preparation, and, second, the defense program is to be doubled, at least so far as required plant capacity is concerned. During this expansion of productive capacity, obviously there will be necessity for curtailment of other contemporary business because of shortage of certain materials and limited supply of certain classes of skilled labor.

Why a Larger Plant?

THE DOUBLING of industrial capacity for production of military goods has long been anticipated. Definite decision to undertake this enlargement is based on certain assumptions; and these assumptions do not include any expectation that there will be four million American men under arms in active fighting, even though we shall have munition and subsistence programs sufficient for that number of men. The reason is quite different.

America is to be the arsenal of anti-Axis nations. Our production program, therefore, will supply and equip not only our own army during training but also will aid in the munitioning of Britain, Greece, China, and perhaps others. American forces may become involved in fighting later, despite every effort and sincere hope to avoid that contingency. But whether they do or not, this country is in effect already in the war so far as supply of goods, all the way from canned fruit to airplanes, is concerned.

The necessity for this is evident when one appreciates the great difficulty which the British Empire is experiencing in providing a continuing adequate supply for troops in England and in the various Colonial expeditions, those now active and those contemplated. And, one must not forget that the United States will be the arsenal for Latin America, too, if there be need for goods or equipment there.

Despite this preparation it is a reasonable expectation that actual manufacture probably will not reach the total of the double program at all soon. Perhaps it never will. Probably it never will if America stays out of the shooting war.

Strategic Stocks

A COMPREHENSIVE STATEMENT of the R.F.C. part of the program of building strategic material stockpiles was made public on Jan. 18 in the form of a letter report from Administrator Jesse H. Jones to the President, dated Jan. 16. On that date R.F.C. had made commitments of about $1,100,000,000. The table on page 114 shows how nearly $400,000,000 had been committed for the mineral program. In addition, there were other commitments, for rubber $190,000,000 for defense plant construction $350,000,000, for industrial defense loans $127,000,000, and for other industrial supplies through Defense Supplies Corporation $55,000,000. This last subsidiary has committed most of its funds for aviation gasoline, $50,000,000, wool $12,000,000, and Chilean nitrate, $5,000,000.

Successful development of the stockpile programs is contemplated if shipping space for movement of foreign goods can be obtained. Government experts are not too optimistic on this point, however. This fact is evident from the plan with respect to purchase of Chilean nitrate. About 300,000 tons of that mineral have been bought from Chilean firms, but only one-third of that total is to be brought at once from that country to the United States. Such a policy obviously would not have been adopted had adequate shipping been promptly available. This fact is also demonstrated by the statistics of the mineral stockpile table, which shows that much of the metal commitment represents goods on order which are not yet even afloat, though the orders have generally been placed for weeks or months.

It should also be remembered that the R.F.C. stockpile data here presented do not include other purchases by the government through the Procurement Division of the Treasury nor commercial stocks held by industry, nor a few other supplies which the Army, Navy, and other government agencies have managed to accumulate without R.F.C. aid.

Metal Price Complaints

TWO DIFFERENT TYPES of metal price controls have been encountered by Commissioner Leon Henderson, who is charged with keeping industrial prices within bounds. His effort on control of copper prices by extensive import has been successful. By other technics some of the other prices have been controlled where adequate supplies were available or could be provided. But when his attack was made on iridium prices a quite different set of mineral facts developed.

No one questions that the price of iridium was advanced sharply during the latter part of 1940. Quotations jumped, according to Mr. Henderson, from $65 in 1939 to about $148 by October, 1940. Then the price doubled again. This led to an official statement that "There is no justification whatever for the sharp advance in the price of iridium culminating in a jump in November and December from $148 per ounce to $300 or more."

Investigation by technical men developed the fact that most of this advance was in the price charged by the Russian producers—that is, the Soviet government—to those who desire to import raw material for refining to make the necessary supplies of iridium. The mark-up and charge for refining in the United States were apparently about normal, according to the understanding of others in the government who seem equally concerned but less disposed to charge "no justification whatever."

Apparently there is a radical difference of opinion within government circles as to whether the requisite quantities of relatively rare materials like iridium will be forthcoming without such increases of prices as would normally seem altogether out of reason.

Some mineral economists also point out that the government cannot expect to stimulate production in the United States of certain other mineral products unless the price is allowed to advance sharply. This more conservative group of officials apparently feels that the law of supply and demand, as it affects the stimulation of production of materials otherwise marginal in cost and price, cannot be ignored even for defense reasons. Scrap zinc and zinc ore are commodities mentioned in this connection. Scrap iron is another; for the junk man will not dig out the relatively inaccessible stocks of scrap unless he is compensated for the unusual effort involved.

This clash between two official opinions finds no support, however, for the theory that any price runaway should be encouraged. The real problem for the conservative group is to figure out some way to permit encouragement of supplemental production without having the bulk of the production carry unwarranted price increases. Discrimination in pricing may be attempted. But nobody claims to know just how it would work, or whether.

New O.P.M. Staff

THE NEW Office of Production Management, headed by Roosevelt's dual personality, "Mr. Knudsen-Hillman," has blanketed into its personnel the mining and minerals products section of the old Defense Commission under a new boss. The new chief is George M. Moffett, president of Corn Products Refining Co., who was assigned to the post in line with the new O.P.M. policy of naming to major division posts men from unrelated fields of industry. This policy protects the individuals against charge of bias as well as minimizes any actual distortion of policy that might perhaps occur through undue intimacy with business affairs involved in government contracts.

The major framework of O.P.M. contemplates three functional divisions dealing with Purchases, under Donald M. Nelson; Production, under John D. Biggers; and Priorities, under E. R. Stettinius, Jr. In the Production division there is a raw-materials section. It in turn is subdivided into three parts. One deals with agricultural and forestry products; a second deals with chemicals and related materials; the third, under Mr. Moffett, is the minerals and metals section. It, of course, is the one of greatest concern to the mining and mineral industries; but even so it should not be forgotten that priority matters

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*From Sharples Amyl Alcohol

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will be handled by an entirely different group under Mr. Stettinius, as indicated.

Mr. Moffett, who now heads the mineral and metal group, has taken over the entire mineral consultant and advisory staff which formerly worked in the National Defense Advisory Commission. Dr. C. K. Leith heads this group and is assisted by all of the mineral specialists formerly working on analogous problems. Thus continuity of planning is assured and the experienced skill of able men well acquainted with the industries continues to care for technical matters. Only when policy questions of major significance arise must the program be taken up to Mr. Moffett and his confreres who are unacquainted with the detail of these industries.

1941 Mines Committees

▶ The states of Washington, New York, Louisiana, and Connecticut each gained seats on Congressional mines and mining committees for the 1941 session at the expense of the states of Arizona, Maryland, and Arkansas. There was one vacancy on the House committee last year. On the Senate side, freshmen Senator Berkeley L. Bunker, of Nevada, was given a committee appointment, replacing the late Key Pittman as that state's representative. A similar substitution brought Senator Harley M. Kilgore, of West Virginia, to the committee in place of defeated Senator Rush Holt. Third new Senate committee member is Senator Mon C. Wallgren, of Washington, who was named to the vacancy created by retirement of Senator Carl Hayden, of Arizona, to give a Senate line-up ranked by seniority, as follows:

Chairman: Joseph F. Guffey, of Pennsylvania.

Democrats
William J. Bulow, South Dakota
Elbert D. Thomas, Utah
Edwin C. Johnson, Colorado
H. H. Schwartz, Wyoming
Albert B. Chandler, Kentucky
Berkeley L. Bunker, Nevada
Mon C. Wallgren, Washington
Harley M. Kilgore, West Virginia

Republicans
James J. Davis, Pennsylvania
Clyde M. Reed, Kansas
Robert A. Taft, Ohio
Alexander Wiley, Wisconsin

On the House side, Representative A. B. Kelly became Pennsylvania's member in place of Guy L. Moser, while Alfred F. Beiter, New York; James Domengeaux, Louisiana; and William J. Fitzgerald, Connecticut, were named to the Democratic side to fill one hold-over vacancy and two others caused by retirement of Representatives David J. Ward, of Maryland, and Fadjo Cravens, of Arkansas. Republicans replaced Earl R. Lewis, of Ohio, with C. W. Bishop, of Illinois. The new line-up follows:

Chairman: Joe L. Smith, of West Virginia

Democrats
Andrew L. Somers, New York
J. Hardin Peterson, Florida
Robert T. Secrest, Ohio
Harold K. Claypool, Ohio
Lindley Beckworth, Texas
W. F. Norrell, Arkansas
John R. Murdock, Arizona
Jennings Randolph, West Virginia
Alfred F. Beiter, New York
A. B. Kelly, Pennsylvania
James Domengeaux, Louisiana
William J. Fitzgerald, Connecticut

Republicans
Harry L. Englebright, California
John M. Robsion, Kentucky
Fred Bradley, Michigan
Gerald W. Landis, Indiana
Ivor D. Fenton, Pennsylvania
Thomas D. Winter, Kansas
C. W. Bishop, Illinois

Vito Marcantonio, New York, American Labor
Anthony J. Dimond, Alaska delegate, Democrat

Magnesium Developments

DEMAND FOR MAGNESIUM has multiplied many fold, and the estimates of requirements continue to grow regularly in Washington. Unofficial news releases of the Capital City indicate that a Western construction company group headed by Henry Kaiser is expected to build a large magnesium plant in California. The news comment indicates a capacity of about 12,000 tons of metal per year. This would not quite equal the reported capacity just being completed at Freeport by Dow Chemical Co. Still further activity in Washington indicates that other companies are also contemplating manufacture of this light metal.

The magnesium situation is also radically complicated by the group of criminal indictments in the Federal court at New York which were returned by a special grand jury on Jan. 30. The charge in that case is based on alleged violation of anti-trust laws. The government claims that by using patent pools there has been price fixing and restriction of production to the detriment of the defense work. The companies indicted included Aluminum Company of America, the I. G. Farbenindustrie, Dow Chemical Co., and certain affiliates or subsidiaries. Nine officials of these companies are also included in the indictment.

In commenting on this procedure, certain officials emphasize that by the trials of these cases it is hoped that the government may determine the extent to which German monopoly influence has been at work in controlling both price and production of magnesium in the United States.

News "Fines"

Engineers Wanted—Civil Service positions for metallurgists, metallurgical engineers, chemist-petrographers, and technical editors of various grades are difficult to fill. Applicants may, therefore, apply any time during this calendar year and secure a Civil Service rating on the basis of training and experience. The Bureau of Mines and other Federal agencies hope that there will be many applicants, but they are more hopeful than confident under present circumstances of industrial demand for competent men. Further information and application forms may be obtained from the Secretary of the Board of U. S. Civil Service Examiners at any first- or second-class post office, or from the U. S. Civil Service Commission, Washington, D. C.

Mine Inspection Bill—The proposed bill to make the Department of the Interior responsible for Federal mine inspection has been reintroduced in the new Congress. It, as its predecessor of the last Congress, deals only with coal mining. But the metal and non-metallic mining industries can safely conclude that if this coal mine safety bill passes there will be another measure enlarging the Federal authority within a short time thereafter.

Tin in Alaska—There is little chance that Alaskan Delegate Anthony Dimond will be able to secure passage of his House bill appropriating $2,000,000 for an immediate survey of the tin resources of Alaska. But a smaller sum is almost sure to be provided for the U. S. Geological Survey to make that inquiry next summer. It is well known that there are both alluvial and lode occurrences of tin in that Territory. While we are spending so much to buy tin stocks, to build a tin smelter, and to bring Bolivian tin ore to the United States, there is no argument that sounds at all convincing why Delegate Dimond should not have his idea approved, even though he does not secure the large appropriation first requested.

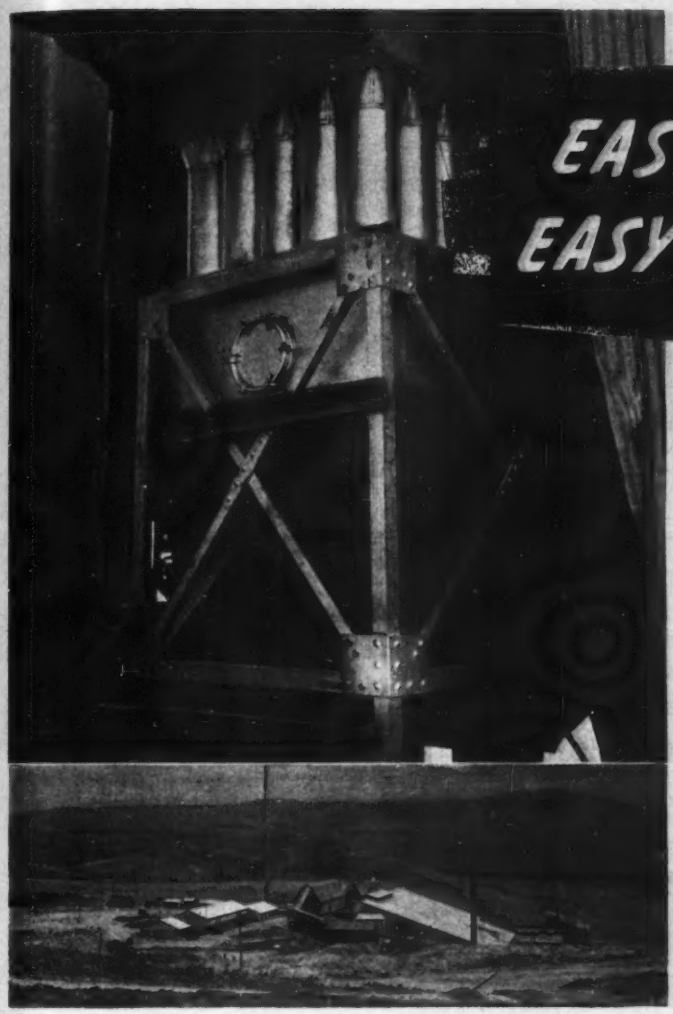
Mineral Procurement

Metals Reserve Co., R.F.C. Subsidiary, Announced the Following Commitments for Strategic Metals and Minerals on January 16

Note. On Feb. 1 Metals Reserve purchased an additional 100,000 tons of Latin-American copper. Deliveries approximating 25,000 tons monthly will begin in March.

	Tons On Hand	Tons Afloat	Tons On Order	Amount
Antimony				
Chinese	2,352	3,898	.....	$1,750,000
Domestic	.....	.....	3,000	780,000
Chrome ore				
South African	.....	.....	100,000	2,140,000
Philippine	.....	.....	100,000	1,800,000
Copper				
Latin American	.....	.....	100,000	22,400,000
Graphite				
Madagascar	411	.....	.....	35,200
Manganese ore				
Far Eastern	34,237	54,860	447,040	15,434,000
Latin American	1,943	.....	276,000	9,254,000
Domestic	.....	.....	1,335,000	46,256,000
Tungsten trioxide				
Domestic	.....	.....	1,250	2,875,000
Tin				
Far Eastern	13,985	6,720	(a)54,295	84,000,000
Bolivian	.....	.....	90,000	100,000,000
Antimony, wolframite, and tin—Chinese (respective quantities undetermined)	.....	.....	.....	90,000,000
Total				$376,724,200

(a) Includes 40,070 tons for which purchase contract is not yet executed.



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MULTICLONE Dust Collectors are compact and may be located in otherwise useless space, yet afford high operating efficiencies. The illustration shows a MULTICLONE fitted into a restricted space in an existing structure at Getchel Mine, Inc., Winnemucca, Nevada.

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These are only a few reasons why MULTICLONES enjoy an outstanding position in the collection of all kinds of dust for the elimination of a nuisance or the recovery of values.

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A recent installation collects metallic values from six hundred thousand cubic feet of hot gas every minute.

Another installation eliminates the fly ash nuisance from 200,000 c.f.m. of boiler stack gases.

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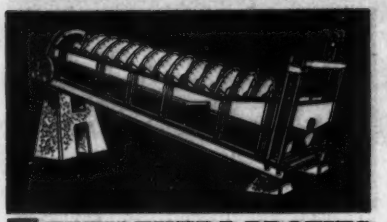

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The Clyde Engineering Co. Ltd., Granville, N. S. W.

New concentrating equipment, treating about 300 tons of silver, lead, zinc ore of the Tamarack & Custer Consolidated Co., is housed in the large building in the right foreground. The mine, also known as the No. 7, is in the Coeur d'Alene district, Idaho

IDAHO

Shaft Sinking Marks 1941 Program at Several Mines

Lead-zinc and silver properties plan for greater output this year—Ball-Interstate mine, at Deadwood, being rehabilitated

▶ Hope Silver-Lead mines, at Clark Fork, will sink an additional 450 ft. of shaft, according to Albert Nash, of Clark Fork, president and manager. Work planned will attain a depth of 1,000 ft. below the tunnel level and give three new stoping levels to exploit. The property is equipped with a modern flotation mill.

▶ Coeur d'Alene Mines has resumed sinking operations from the 1,400-ft. level to the 2,000-ft. level. About 300 tons of tetrahedrite silver ore is produced daily from the 1,400-ft. level.

▶ The Hall-Interstate mine at Deadwood, Valley County, idle for many years, resumed operations in January, according to Leverett Davis, of Salt Lake. Fifteen men are at work repairing old workings. Work at the mine ceased in 1932, when the Bunker Hill & Sullivan was operating there. A few years ago a cloudburst above the mine buried tunnel entrances and buildings. A landing field for airplanes has been cleared for use if the road is closed by snow. A 100-ton flotation mill will be put in operation on the lead-zinc-silver ore.

▶ Liberal King mine, in the Pine Creek district, west of Kellogg, scene of a recent ore strike, now has 11 ft. of high-grade lead-zinc ore uncovered on the 1,000-ft. shaft level, according to Manager H. G. Weber, of Rose Lake. Plans for a milling plant are being made.

▶ W. M. Yeaman, of Yakima, manager of the Sunshine Consolidated property on Big Creek, reports that the crosscut being driven into the Consolidated from the 3,100 level of the Sunshine Jewell shaft has proceeded 700 ft., leaving about 500 ft. to reach a point where diamond drills located a vein of high-grade silver ore.

▶ The Almaden quicksilver mine, at Weiser, now rates as the seventh largest producer of mercury in the nation. The property is owned by Herbert Hoover, Jr., and Allan Hoover, sons of former President Herbert Hoover, and L. K. Requa, engineer and manager. Production was started in 1939 after the outcrop had been discovered by a sheepherder. The company has a 50-ton mill and is producing at the rate of 7½ lb. quicksilver to the ton of ore milled.

▶ A new $70,000 milling plant has been ordered for the Horn Silver mine, near Martin, being developed by the Erie Mining & Development Co. William E. Clark, of Idaho Falls, is manager. Concentrates will be shipped to the Garfield, Utah, smelter.

▶ The Marshall lake area of Idaho County is enjoying a gold boom, with five properties under steady development, according to Arthur Campbell, state mining inspector. Golden Anchor Mining Co., with a crew of 54 men, completed 4,598 ft. of development work during 1940 and installed a new diesel plant. Net profits totaled $184,796 for the year. George Kingdon is president and J. W. Sievwright, secretary, both of Jerome. W. Buford Davis is general manager, with headquarters at French Creek, Idaho. Goodenough United Mining & Milling Co. is being worked under lease by the Two Margarets Mining Co., headed by Cornelius Meyers, of Portland, Ore. A crew of 15 men is employed.

▶ Idaho Klondike Mining Co., located on California Creek, reports 250 ft. of development work, with four men employed. The property is an underground placer which taps an old river channel. Mark Evans, of Burgdorf, is president in charge of operations. Gold Crest Mining Co., adjoining the Golden Anchor, has 15 men driving a crosscut to determine the extent and value of ore-bodies at depth. E. T. Fisher, of the Warren Dredging Co., is manager.

▶ The United States Supreme Court has denied the petition of the Sunshine Mining Co. for review of a National Labor

Relations Board order finding it guilty of unfair labor practices and directing it to bargain with a C.I.O. union committee. The company challenged the right of the board to intervene in the case, contending the mine is engaged in purely intrastate activities beyond NLRB jurisdiction. Sunshine also contended that the overwhelming majority of its workers were not members of the C.I.O. at the time of the labor board hearing. The board, the mining company claimed, abused its discretion in ordering back pay which would amount to about $300,000.

▶Final arrangements have been made by the Sunshine and Metropolitan mining companies whereby Sunshine will drive a 3,000-ft. crosscut into Metropolitan ground from the 3,100-ft. level of the Sunshine shaft. The first ore expected to be encountered will be the Sunshine's Yankee Girl vein, which will be reached in approximately 1,000 ft. Metropolitan has three veins which will be explored.

COLORADO

Mines Await Completion of Carleton Tunnel

Several properties preparing for deeper mining as soon as long drainage project is finished—Alma Lincoln Mining Co. increases holdings

▶The Carleton tunnel is steadily advancing to the area of draining waters from the Ajax, Portland, and other properties. On Jan. 11, the bore reached 27,151 ft., where a flow of 8,000-g.p.m. of water was encountered. This soon dropped to about 400-g.p.m. Laterals will be driven in the direction of the Vindicator and Cresson mining operations upon completion of the tunnel. When water from the Ajax mine is reached benefit to the Golden Cycle mine is expected, while the United Gold Mines will derive direct benefit as soon as the Portland is dewatered, permitting work on the lower levels of the Portland. Then, according to present plans, the United Gold Mines Co. will pick up the tunnel heading at the Portland and carry it directly on through to its Vindicator and Golden Cycle properties.

▶Alma Lincoln Mining Co., organized in 1933, has paid $125,000 in dividends. The company has recently taken under lease the Cardigan holdings, consisting of four claims just east of the Elliott & Barber tunnel through which the Alma Lincoln operates. Clyde Lyon is in charge of the operations, as well as those of the Lord Byron. The company also purchased an interest in the Metropolitan group of 29 patented claims.

▶Western Mines, Inc., with headquarters at Colorado Springs, has nearly completed the erection of a 250-ton mill building on its properties near Montezuma. Installation of selective flotation equipment is being made, and the mill is expected to be ready for operation in April.

▶A 75-hp. electric pump has been installed at the Argentine shaft of the

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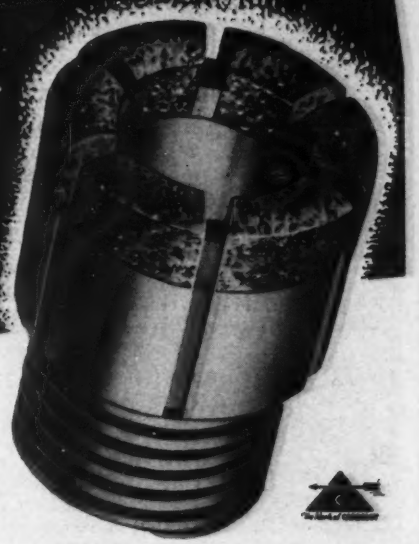

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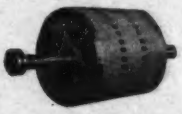

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▶COLORADO

Rico Argentine Mining Co., at Rico, to unwater the old workings of this lead-zinc property. A third shift was recently added to the payroll.

▶ Shipments of ore to the Shenandoah-Dives custom mill at Silverton, in 1940 were the largest in the history of the mill.

▶ During 1940, Cresson gold mine produced a gross of $1,165,000 in spite of a 30-day curtailment in operations; 113,500 tons of ore with an average value of $10.27 per ton were shipped to the Golden Cycle mill. The average was 37c. higher than in 1939, and 87c. higher per ton than in 1938. Alfred Bebee, vice president of the Carlton interests, is in direct charge of operations.

▶ The Pride mill, at Howardsville, constructed by the Denver Equipment Co. under the direction of Fred A. Brinker, during 1940, is reported operating continuously, obtaining a high metal recovery.

▶ The newest enterprise in the Idaho Springs section is the Idaho Metals Co., with holdings in the Trail Run and Dumont districts. The orebodies in the Trail area have been uncovered by surface development and a tunnel has been started to encounter them at depth. Preliminary work having been completed, heavy production is expected this spring, when the Ohio Gulch road in the Dumont district, which is being rebuilt, is completed; and which opens the road to the Iron Deer group of mines, which the company plans to develop.

▶ The properties of the Stratton Estate, comprising more than 650 acres in the Cripple Creek district, produced a total of 31,000 dry tons of ore, with a gross value of approximately $341,000, during 1941. More than 8,000 ft. of development work was done in the various properties, with 16,783 man-shifts worked. D. P. Strickler, of Colorado Springs, is president, O. B. Keener, superintendent, and Joseph C. Twinem, assistant superintendent.

Colorado Miners Observe Silver Week

MEMBERS of the Colorado Mining Association met in their 44th annual convention in Denver, Jan. 24 and 25. Emphasis was put on silver as a monetary metal, and featured by a charming Silver Queen, a silver banquet, a silver speech by Senator McCarran, of Nevada, and exchange of silver dollars for dimes minted in Denver in 1941. The annual Sowbelly Dinner was attended by over 1,200 miners.

Sessions were devoted to technical and economic subjects, all having more or less close relations to the war. The importance of minerals in world affairs was presented by Carroll E. Dobbin, U. S. Geological Survey; the effect on mining of the Revenue Act of 1940 was discussed by Henry B. Fernald. Other economic and political subjects and their authors, were: "The Future of Gold and Silver," Walter E. Trent; "Public Land Policy," Charles E. Winter; "Fair Labor Standards Act," Burt B. Brewster; "Social Security Act," George W. Guth; "Marketing Non-Metallic Minerals," Paul M. Tyler and H. H. Hughes, Bureau of Mines, and Carl Zapffe; "Marketing Manganese," Gustavus Sessinghaus.

Technical subjects and their authors were: "Safety Practices," J. K. Richardson; "Radio-active Exploration," R. Burton Rose; "Cripple Creek Geology," A. H. Koschmann; "New Developments in Mining and Milling Practices," A. B. Reeves.

T. A. Rickard was the speaker at the Silver Banquet, his subject being: "The Flag Follows the Pick." H. C. Parmelee, editor of *Engineering and Mining Journal*, spoke at the Sowbelly Dinner—"It Happened in '66."

Officers of the association were re-elected: Jesse E. McDonald, president; Merrill Shoup, Edward Thornton, Harry C. Bishop, and Walter F. Scott, Jr., vice presidents; Charles N. Bell, treasurer; and Robert S. Palmer, secretary.

UTAH

Veteran Employees at Utah Copper Feted

Gold medals and banquet given to 42 serving more than 20 years—Manganese deposits in Juab County being prospected

▶ Colonel D. C. Jackling arrived in Salt Lake City Jan. 19 to make awards to 42 veteran employees of the Utah Copper Co. of medals for long service. More than 500 persons were invited to the banquet at the Hotel Utah, held on Jan. 21, at 6:30 p.m. Employees serving 20 years with the company were given gold medals, lapel buttons, and certificates by Colonel Jackling. C. M. Brown, superintendent of welfare, acted as toastmaster.

▶ Drum Mountain manganese deposits in Juab County are being prospected by two diamond drills operated two shifts daily, under the direction of the Salt Lake office of the U. S. Bureau of Mines. Richard Lee, engineer, is directing drilling and sampling.

▶ New ore has been found on the 700 level of the New Park mine, reports W. H. H. Cranmer, president and general manager. James W. Wade, president and general manager of the Tintic Standard Mining Co., has been made a director of the New Park mine.

▶ Stockholders of the Wasatch Gold Mines, Inc., recently voted to change the name of the company to the Mountain Mines Company. The tunnel being driven near the crest of the divide in Big Cottonwood Canyon recently passed the 2,000-ft. mark.

▶ The face of the Elton Tunnel of the National Tunnel & Mines Co., near Tooele, on Jan. 18 stood at 21,300-ft. distant from the portal, with 3,000 ft. yet to go to reach the objective Bingham ore deposits. During the first 18 days of the month, the tunnel was pushed 546 ft. forward in the quartzite formation. A small piece of drag ore, it is reported, was found at 21-188 ft. Completion of the 4.5-mile tunnel is expected in April.

▶Mercur Dome Gold Mining Co. resumed sinking of its shaft at Mercur at a depth of 700 ft. The company has about 180 ft. to go to reach the objective Madison limestone.

▶Miners in the Valco mine, East Park City, recently struck a 3-ft. mineralized fissure. Operations of the Great Buffalo Mining Co. have been stopped for the winter. Officials report that the tunnel of the Park Valley mine, in Box Elder County, has been extended to the 600-ft. mark. Work will be resumed in the spring.

▶Hercules Mining Co. plans to start work at three points in its Stockton Canyon property to develop ore opened up by leasers on the 250-ft. level.

▶Treasure Hill Mines Co., operating under lease in the Madison Mines property in the Dry Canyon area of the Ophir Hill district, has advanced its incline toward the Madison limestone a distance of 900 ft. The Treasure Hill Co. is sinking its incline shaft toward the Hidden Treasure formation at the rate of 10 ft. daily.

WASHINGTON

Pend Oreille Mines Pays Off Power Bonds

Mine and mill of company is operating at capacity—Tests on finer grinding being undertaken at Holden copper mine

▶Pend Oreille Mines & Metals Co., at Metaline Falls, has paid off in the last six months the final $100,000 of the $300,000 6 percent power bonds it issued for the construction of the power plant below the town, according to Jens Jensen, of Spokane, secretary. The company has been operating at capacity, employing 150 to 160 men. The bulk of its output is zinc, and shipments of zinc concentrates have been steady, but for six months the company stored its lead concentrates because of the strike of the Selby smelter, in San Francisco. Shipment of these accumulated lead concentrates, amounting to 1,500 tons, was resumed in December.

▶C. P. Browning reports the experimental ball mill for use in determining a better recovery for the copper ore at the Howe Sound's Holden mine was completed and put in operation in December. Four ball mills are in operation at the mine, with all ore going into the new mill for regrinding. John J. Curzon is manager of this property, 43 miles up Lake Chelan, in the Cascades.

▶Gold Hill Operating Co., adjoining the Azurite Gold mine, Whatcom County, has completed arrangements for an aérial tramway down the west side of the Cascade range, according to Barclay O. Goodsell, Spokane mining engineer. The company expects to build a mill on Granite Creek and to use the tramway for moving ore and supplies.

▶Admiral Mining Co., at its new property, 8 miles south of the Canadian line between Orient and Northport, has exposed a vein 35 ft. wide by an 80-ft. cut.

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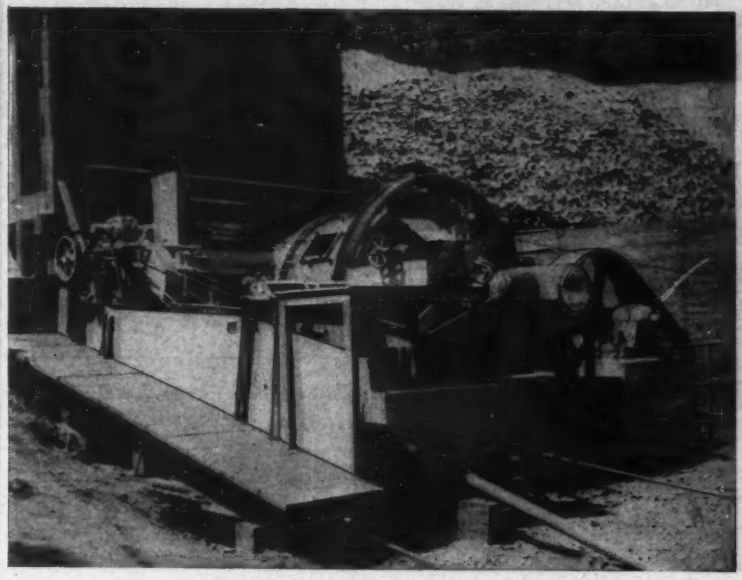

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The Grandview mill, operated by the Metaline Mining & Leasing Co. at Metaline Falls, Wash., is treating about 400 tons of zinc-lead ore daily, from the Grandview and Metaline mines. The American Zinc, Lead & Smelting Co. directs operations at these properties

▶WASHINGTON

The ore is a mass of quartz, carrying iron and copper, with some gold and silver, according to J. Richard Brown, Spokane mining engineer and manager.

▶ The Methow Gold Corporation, following recent organization, has become the most important gold producer in north central Washington, west of the Republic district. Output valued at $348,259 was produced by the end of the year. Shipment totaled 330 cars of crude ore and 38 of concentrates. The property is in the upper Methow valley.

▶ Grandview Mines Co., at Metaline Falls, is receiving nearly $5,000 a month as its royalty share of profits from the operations of its mill and mine by Metaline Mining & Leasing Co. The mill is handling about 400 tons of ore a day, half from the Grandview mine and half from the Metaline Mining property. Millheads on Grandview ore are said to be running at least 10 percent zinc. H. Louis Schermerhorn, of Spokane, is president of Grandview.

IRON COUNTRY

Ore Being Stockpiled For Early Spring Demand

Pickands, Mather & Co. planning to build a washing plant at Majorca mine, near Marble, Minnesota

▶ Consumption of Lake Superior iron ore during December 1940 amounted to 6,173,038 tons, the largest consumption since accurate records have been kept. The total for the year 1940 was 62,426,-314. Stocks on hand at Lake Erie furnace yards and docks amounted to 36,072,833 tons as of Dec. 31, 1940, and if consumption continues at the same rate stocks on hand will be about 12,-000,000 as of May 1, 1941. Naturally, it will be necessary to have an early opening of navigation and a late closing if the estimated 75,000,000 tons be carried down the Lakes.

Mesabi Range

▶ Pickands, Mather & Co. are carrying on with a large stripping program at the Scranton mine, at Hibbing, Minn., and also making plans to build a washing and jigging plant at the old Majorca mine, near Marble, Minn. This mine was formerly operated by Pickands, Mather & Co., but the old plant was dismantled several years ago. Additional men have been added to the force at the old Dunwoody mine, at Chisholm, Minn.

▶ The Interstate Iron Co. is busy with the large stripping program at the Hill Annex mine, at Calumet, Minn. This mine is operated by electric haulage, the entire mine having been electrified several years ago.

▶ North Range Mining Co., of Negaunee, Mich., has completed pumping installations at the Schley mine, at Gilbert, Minn., and the E. W. Coons Co., of Hibbing, Minn., has started stripping.

▶ Butler Bros. continue to push a large stripping at the Galbraith mine, at Nashwauk, and also a new plant will be built at this mine.

▶ Oliver Iron Mining Co. is stripping at practically all mines on the Mesaba range and stockpiling ore from the underground mines.

▶ Charleson Iron Mining Co. will operate the Harris and Judd mines during the 1941 season.

▶ M. A. Hanna & Co. will reopen the Wabigon mine, at Buhl, Minn., to enter the 1941 shipping season. This mine is completely electrified.

Cuyuna Range

▶ E. A. Young, of Minn., a contractor, is loading stripping for the Evergreens Mines Co. at a new mine being opened between Keewatin and Nashwauk. A new washing plant will be built for the 1941 season.

Marquette Range

▶S. R. Elliott, mining manager, Cleveland-Cliffs Iron Co., broke ground on Jan. 6 for a new shaft to be sunk 2,900 ft. and later to 4,000 ft. in Ishpeming. Shaft sinking is on a six-day week basis. The largest steel headframe in the Lake Superior district, nearly 192 ft. high, will be fabricated by the Worden-Allen Co., and erected at this mine. A crushing plant will also be installed at the shaft. Feature of this large headframe will be an electrically operated passenger elevator pushbutton control to elevate men to positions in the headframe. Ore will be hoisted in 12-ton skips. The shaft will measure 13x19 ft. inside the timbers.

▶The North Range Mining Co., of Negaunee, Mich., has adopted a group program which provides more than 300 employees with a total exceeding $520,000 of life insurance. Announcement of the plan was made by R. S. Archibald, manager of the company. The plan is being underwritten by the Metropolitan Life Insurance Co. on a cooperative basis whereby the employees contribute fixed amounts and the employer bears the balance of the entire net cost. General employees insured under the plan receive $1,500 life insurance each. The plan also includes visiting nurse care and the distribution of pamphlets on health conservation and disease prevention.

Menominee Range

▶At the Davidson mine, No. 3 shaft, operated by the Pittsburgh Coke & Iron Co., is being deepened from the 400-ft. level to the 535-ft. level, with work on a three-shift basis. Rudolf Erickson is superintendent.

▶About 100 men are now employed at the Tobin mine, Crystal Falls, stockpiling ore for Republic Steel Corporation's early requirements.

▶Pickands, Mather & Co. has started shaft-sinking operations at its Buck and Fogarty mines, operated by its subsidiary, the Verona Mining Co., in Caspion, Mich. The shafts at these two mines are being deepened 150 ft. from the 9th to 10th levels, respectively.

Gogebic Range

▶On Jan. 31, the Oliver Iron Mining Co. surrendered its lease on the Puritan mine, near Ironwood, Mich., because of exhaustion of available ore. This mine produced about 5,300,000 tons of iron ore in its life of 55 years.

Adirondack Iron Ore Mining More Active

▶Republic Steel Corporation will install at the Withersbee-Sherman Mines, Mineville, N. Y., a hoist capable of handling ore from mile-deep shaft. Capacity of mill at the Chateaugay Mine, Lyon Mountain, N. Y., will be increased 15 percent and main hoisting shaft would be extended 650 ft. Robert J. Linney is general superintendent of the company's Adirondack district operations, with offices at Port Henry, N. Y.

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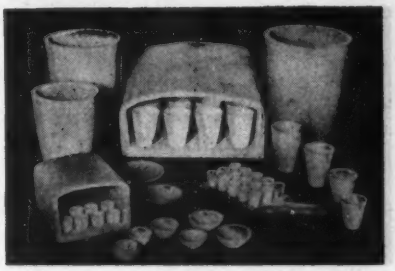

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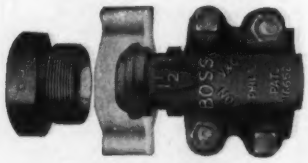

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Mining Congress Elects Officers

MEETING in annual business session at Washington, D. C., Jan. 26, the American Mining Congress devoted most of its time to the subject of taxation, listened to reports of the secretary and treasurer, and elected officers for the ensuing year. Two sessions on taxation were held for the purpose of determining the points on which amendments to the second Revenue Act of 1940 should be sought. It is hoped that amendments may be obtained in time to afford relief on 1940 income tax returns. The secretary reviewed the activities of the Congress for the past year and the treasurer showed that the Congress is financially in excellent condition, with a substantial cash balance.

Officers were elected as follows. Directors for three years: N. W. Rice, J. R. Hobbins, Merrill Shoup, H. I. Young. The directors subsequently elected the following officers: President, H. I. Young; vice presidents, D. D. Moffatt, E. B. Greene, and D. A. Callahan; secretary, J. D. Conover; treasurer, E. V. Daveler.

TRI-STATE

Production Held Uncertain Under Present Prices

Operators believe current high rate of output doubtful unless higher return for zinc will permit exploitation of lower-grade orebodies

▶ Some new activity in the Tri-State district points to the sustainment of present production rate at the prevailing price level for the remainder of the winter, provided weather conditions are favorable for operations. Weekly output has been averaging recently between 8,500 and 9,000 tons. A further stimulus pricewise is needed to increase production and to prolong the life of the field, in the opinion of a large percentage of the operators. This is due to the near depletion of richer orebodies and the necessity of mining and milling of low-grade ore reserves. Unless a better price materializes it is doubtful, in the opinion of many ore producers, that the present output rate can be maintained long.

▶ Smoky Hill Mining Co. is completing a new 200-ton Joplin-type mill on the original Quapaw mining lease, north of Commerce, according to Claude Holden of Commerce. W. L. Turner, of Commerce, is the millwright. Associated with Holden in the company are Louis Grimes and Sidney Walker, both of Commerce, and Perry Porter and Lloyd Newton, both of Miami.

▶ Preparations are being made by the Capital Mining Co. to reopen the old mines and mill of the Loklyn Lead & Zinc Co. just west of Stotts City. The properties are expected to be in production in April. The mines are being dewatered and a 200-ton mill on the lease is being reconditioned. Approximately 30 men will be employed with the start of operations. B. T. Smith, of Carl Junction, will be superintendent.

▶ An old field shaft on the Crane lease in the east part of the old Thoms Station mining area, northwest of Joplin, is being reopened by the Hopi Mining Co. The lease is a part of the old Grasselli holdings acquired last year by the St. Louis Mining & Milling Co., which subleased the 80-acre tract to the Hopi company. A new derrick and 220-ton hopper are being constructed over the shaft, which will be dewatered to the 182-ft. level, where mine operations will be carried on, according to C. F. Denney, of Joplin, company manager.

ALABAMA

Operators and Union Discuss "Collar to Collar"

Closing dates for briefs advanced to Feb. 20—Tennessee Coal, Iron & Railway Company's red-ore mines move to two-shift basis

▶ The issue of what constitutes an eight-hour day in the ore mines was argued in a two-day hearing before Harold Stern, assistant chief of the hearings branch of the Wage and Hour Division in Birmingham on Jan. 14–15, following a visit by Stern to one of the mines of the Tennessee Coal, Iron & Railroad Co. to personally observe conditions in this mining field. At the request of participants in the informal fact-finding conferences held in Salt Lake City, Utah, and Birmingham, the closing date for briefs was extended from Feb. 10 to 20. A statement of Edward Ball, general superintendent of mines and quarries of the Tennessee Coal, Iron & Railroad Co., was read into the record by Borden Burr, counsel for this company, to show that any change in the present eight-hour working day plan will cause an annual production loss of 8.33 percent, or 381,000 net tons, and the loss in bonus earnings for ore miners in the Birmingham area. Ball's statement as well as that of other companies in the Birmingham district was in defense of the "face-to-face" method of figuring the work day as opposed to the "collar-to-collar" or "portal to portal" method sought by the union. Leo Pressman, counsel for the Congress for Industrial Organization presented witness after witness to show the time required to get from the mouth of the mine to the point of work, and the time required on the return, time for which they did not get paid, although subject to company rules, and often required to do odd jobs, such as moving timbers, getting tools together, etc. The testifying miners also complained of little or no lunch time and that they were not allowed to discuss union matters in the mines. The miners said this extra time spent on mine property for which they received no pay averaged one hour to one hour and a half.

The hearing was opened in a statement read by Reid Robinson, of Denver, president of the International Union of Mine, Mill & Smelters Workers and vice-president of the CIO, who urged that a ruling be adopted which requires that "the eight-hour period begins when the em-

ployee begins to work or is required to report for work, whichever is the earlier, and his time is counted so long as he is required to remain in his place of work." He added that in the Birmingham ore mining industry "the definition of the work day has through the year been the subject of considerable discussion and conflict between workers and management. Traditionally management has been economically too powerful for labor to have obtained a reasonable and fair definition of what constitutes a work shift. Management has succeeded in imposing upon labor a work shift which covers many more hours than are actually paid for by the companies."

▶ All of the Tennessee Coal, Iron & Railroad Company's red ore mines are now operating 16 out of every 24 hours, five days a week, the company announced Jan. 15. Wenonah mine, the last of the mines to operate on a single shift only, began working double shifts Jan. 19. Meanwhile, the relining of the only blast furnace in the district not operating is completed and the T. C. H. started its operation early in February.

▶ Woodward Iron Co. has concluded a new two-year contract with the 750 employes of its red-ore mines at Lipscomb which provides for a reclassification of certain jobs and an increase in tonnage pay for others. The contract also provides that employes drafted will be reinstated to their jobs on return. The question of wages is understood to have been left open for negotiation during the life of the contract.

▶ Reynolds Metals Co. has formed a subsidiary, the Bauxite Mining Corporation, to engage in prospecting for and the mining of bauxite. The new company has already put experts into the field in the State of Arkansas. The company's new aluminum reduction plant, located at Lister, Ala., will be in production this spring.

MEXICO

Strike at Rosita Zinc Plant Remains Unsettled

Efforts of company to settle dispute by arbitration and negotiation fail and problem is brought directly to President Comacho

▶ Midwinter found a slight improvement in the Mexican mining industry, with assurance of aid by the government in the form of reducing the special tax on exports, a 12 percent impost that had been in effect for some time and which had burdened the business.

▶ The strike against the American Smelting units at Nueva Rosita, Coahuila, Mexican Zinc, and Cia. Carbonifera de Sabinas, the latter a coal-mining enterprise, which began on Oct. 10, has become so bad that President Manuel Avila Camacho has been petitioned to intervene for its settlement. The union has become tired of financially aiding the Nueva Rosita strikers, aid that has already cost it between 600,000 and 700,000 pesos ($121,000 to $142,000).

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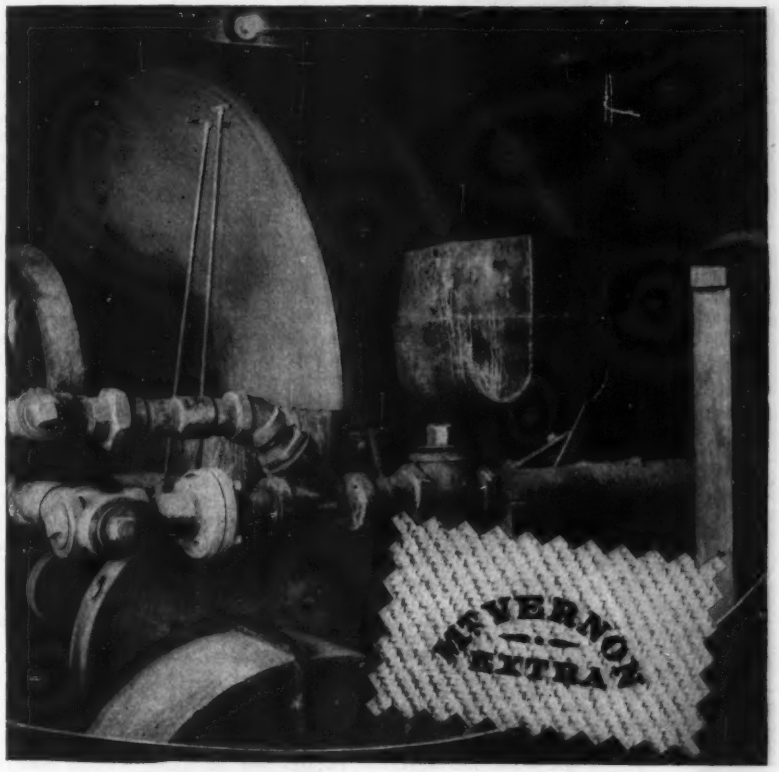

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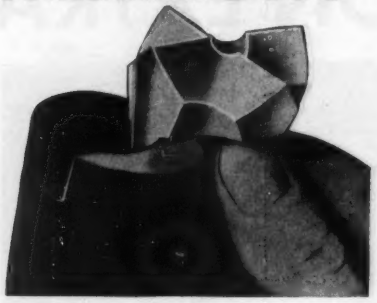

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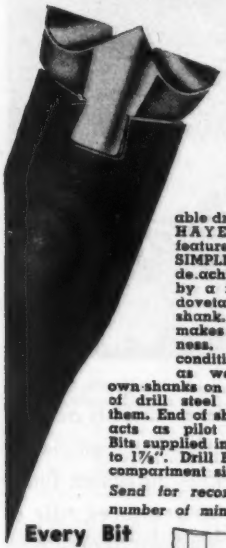

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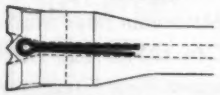

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▶MEXICO

tions of the mining industry have undertaken an overhauling of the mining laws and the regulation of the government's mining policy, because, they say, all mining statutes need modernization. The policy regulation has not been changed since it became effective in 1917. Many congressmen want more attention given social service by this regulation. The program is to be presented to the extraordinary session of congress in February.

▶ The national miners union is arranging private conversations with Kildun Mining, Villa de la Paz, San Luis Potosi, with a view to ending a dispute that has arisen from Kildun's employees' demands for higher pay and other concessions. This action of the union is considered as indicating a better attitude on the part of mining labor, to seek arbitration and tolerent discussion first rather than rushing into strikes that upset the industry and the family life of the miner.

▶ Mining is assured of some relief from tax burdens with the announcement by the Ministry of Finance that the impost on exports, a 12 per cent levy that was enacted two years ago, and which provoked many complaints from the industry, is to be eased this year. It is indicated that this tax may be cut in half. Paring the export tax, the ministry said, will be a direct benefit to mining, which accounts for about 70 per cent of Mexico's exports.

CANADA

Dominion Conference Studies Problems of Industry

Federal and Provincial officials meet in Ottawa and discuss prospecting, taxation, and legislation—Good ore struck in Cariboo Gold Quartz mine in B.C.

▶ One of the most important conferences ever held on Canadian mining took place at Ottawa on Jan. 13. The Hon. T. A. Crerar, Minister of Mines and Resources, and other Federal officials met Provincial ministers and deputies from all parts of the country. The Ontario Securities Commissioner, Roy B. Whitehead, was also present and probably took an active part in shaping recommendations for unifying regulations in all provinces to protect the interests of prospectors as well as investors. Various other steps were taken to stimulate prospecting and mining development in the Dominion. Committees are to be appointed to ease mining taxation and to bring about changes in legislation that will directly benefit the prospector. Both Federal and Provincial governments were urged to train and guide prospectors and, as a means to providing the mining industry with additional labor, due to war conditions, the Federal Government should train men for the trade of mining. It was also advised that more money be provided for a long-term program of mapping to increase the output of geological and topographical maps. Assistance would be given to prospecting and the opening of new mining areas if the former Dominion-Provincial agreements for building mine roads are resumed. It was shown that Canada is making it easy for American money to come into Canada for exploratory work, and for profits and dividends to be taken out in U. S. funds at any time.

Quebec

▶ Figures released in January by A. O. Dufresne, Director of the Quebec Bureau of Mines, show an increase of 6.6 percent in gold output in the province for the eleven months of 1940, 928,914 oz., valued at $35,753,189, compared with 871,347 oz., worth $31,442,399, to the end of November, 1939. Silver production, a byproduct of gold mining, also moved up to 1,201,159 oz. from 1,061,666 oz. in the eleven-month period of 1939. Asbestos declined slightly to 316,614 tons. The official report credits war activities for a drop of more than 30 percent in development work on mining claims and in the staking of new claims. Only 7,324 claims were recorded in 1939–40, against 23,823 claims in 1936–37, which suggests a situation that had its origin in events that came well before Canada entered the war.

▶ Perron Gold Mines has discovered high-grade ore in recent diamond drilling, according to a report by the general manager, J. P. Norrie. The first occurrence is located above the 358 orebody and shows 2.14 oz. across 2 ft. Another new vein has been intersected below the 355 orebody, 2.3 ft. in width and grading 1.0 oz.

▶ Construction of the new 350-ton mill at Senator Rouyn Mines is advancing on schedule, with outside work complete except for the housing on the ore conveyor. Machinery foundations have been completed for equipment that is to be delivered in February. The Arntfield mill is being used under lease. Dr. W. F. James and B. S. W. Buffan are consultants.

Ontario

▶ Four new levels at Little Long Lac Gold Mines have shown an ore length on the main vein of more than 1,400 ft., compared with less than 1,000 ft. above the 10th level, with grade holding about mine average. Deeper development also has disclosed the possibility of opening parallel veins, and has given new importance to the South vein, located 400 ft. south of the main orebody. In April it is planned to start sinking an internal shaft 700 ft. below the deepest horizon in the mine, to establish four levels at 150-ft. intervals.

▶ Macassa Mines reports a tax increase in 1940 of 167 per cent, although it was possible to hold profits at a point slightly higher than in the previous year. Gold recovery of $15.65 a ton in 1939 was increased to $17.60 a ton in 1940; in the last three months grade was up to $18.61.

British Columbia

▶ A major development at Cariboo Gold Quartz mine this month holds considerable promise for the future of that property and indicates a possibility that it will eventually become a big-tonnage operation. The "B.C." vein has been cut by the main haulage tunnel at about 9,000 ft. from the mouth of the adit and about 1,000 ft., vertically, from the surface. Managing Director R. R. Rose in a telegram to the company's Vancouver office stated that "the width of the 'B.C.' shear zone was 15 ft. where it was cut by the main crosscut; the width of solid quartz in the shear zone is 4 ft. on the left wall of the crosscut and 5 ft. on the right wall; the remainder of the zone is crushed schist containing some quartz." The report from Mr. Rose further indicates that the average gold content per ton of the solid quartz on the left wall of the crosscut at this point was 0.3 oz. and on the right wall 0.6 oz. Mineralization is reported as being chiefly pyrite and galena.

▶ Development of a body of high-grade ore, which, officials believe, may extend for a vertical distance of more than 500 ft., is continuing at the Privateer Mine. Owing to the development of new areas, the mill feed may be more irregular in the next few months and in some months may be below average. The general policy will be to resume and maintain production on as even a basis as is possible. D. S. Tait is president.

▶ Col. A. S. McCulloch and associates, of Vancouver, have reopened the old Regal Silver mine, near Albert Canyon, in the Revelstoke district. It is believed that the tungsten content of the ore will make the project financially successful. Samples of the ore have been sent to the Mines Branch at Ottawa for testing. A report made in 1938 indicated that sufficient ore is available to keep the 100-ton mill operating for several years.

Canada

(*Continued from page* 63)

to those formerly imported from France and Norway for grinding feldspar.

According to the Quebec Minister of Mines, the Hon. Edgar Rochette, gold output in 1940 exceeded a million ounces for the first time. The Moss molybdenite mine, inactive since the first World War, has started up on a small scale, as have small chromite properties in southern Quebec. There was an important increase in the production of mica in 1940. New production records were created in cement and clay products.

In Nova Scotia, the Stirling mine, zinc-lead producer controlled by British Metal Corporation, is back in operation after a shutdown of several years and contributing to what is believed to be an all-time high for these metals in Canada. Gypsum output advanced by more than 50 per cent, the large-scale quarrying operations in this province

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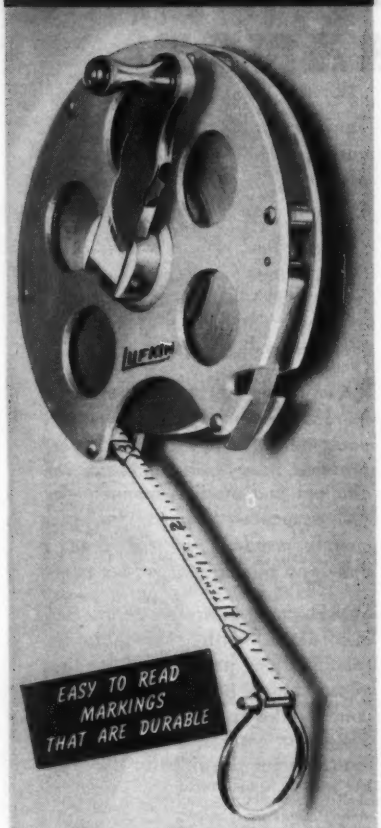

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being greater than combined tonnage from other parts of the Dominion. Coal, with an estimated total production of $17,000,000 from the whole country, was mined in larger than normal quantities at the Sydney, Springhill and Pictou fields.

In British Columbia the forecast value of mineral output is in excess of $75,000,000, compared with $66,000,000 in 1939 and slightly above the previous record in 1937. All gold producers are operating at the maximum rate indicated by ore-reserve position, and the production of bullion is expected to reach a new high of about $25,000,000. One or two new placer operations in 1940 are expected to increase the figure for the previous year of $1,478,492 for placer gold from 90 producers in the Stikine, Cariboo, and Quesnel areas, and additional activity is planned for 1941 in the Atleri area where it is planned to put three complete units. Important production of war metals characterizes the mining industry in British Columbia, where Consolidated Smelters dominate the picture with large-scale output of zinc and lead. Increased chemical production took place in 1940 and a mercury property was placed in production at Pinchi Lake, the largest in the British Empire. There are indications that one or more antimony prospects in the province will go into production in 1941. Granby Consolidated, having enlarged the concentrator and installed a 10,000-kw. steam turbine to increase power facilities at the Allenby mine, has announced definite consideration of plans for building a smelter and converter plant at the Copper Mountain mine.

The incomplete dividend record of Canadian mining companies shows a total disbursement to Oct. 31, 1940, of $83,297,668, with indications that payments to be made in the last two months will bring the total to an all-time high exceeding $105,000,000. With more than half of the producers contributing, there are 91 companies on the list, which is 24 more than in 1939 and 33 more than in the previous year. The newcomers are gold mines except two, Sherritt Gordon and Waite Amulet.

AFRICA

Nchanga Copper Testing Various Deposits

Results obtained on oxide ores reported favorable—Plans call for a large plant to be built following end of war

▶ Although the war is causing some secrecy to be observed in reporting results and plans, and also a great diminution of prospecting and exploration activities, gold mining is being pursued throughout Africa with steadily increasing energy.

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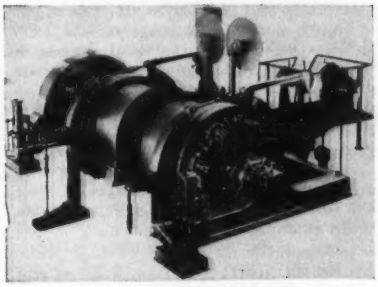

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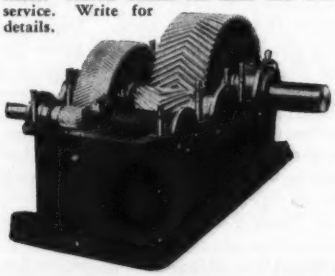

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▶ Nchanga Consolidated Copper announces that the plan to increase the plant to a capacity to produce 5,000 tons of copper per month has been deferred, due to the British Empire's urgent need of the materials for war purposes. In consequence, the shareholders who had agreed to provide £1,500,000 to cover the cost of construction have been released from their obligation. The pilot plant is being extended out of funds in hand and the output of copper increased. Metallurgical results are excellent, particularly in the recovery of copper from oxide ores, and operations have enabled the management to determine both future plant requirements and the best method of mining the ores. The company's already considerable production will gradually be increased. As soon as international conditions become settled the plan for the erection of a large plant will be taken in hand.

▶ Heavier taxation alone will prevent the mines of the Witwatersrand gold district from setting up another new high record of dividend payments this year. Production and operating profits will show substantial increases. The war effort has cut down the supply of European labor somewhat and necessitated some reorganization of staffs, but production is continuing to increase. The outlook for a further considerable increase of output this year is not as bright as it was, however, yet no appreciable decrease is expected. Three new dividend payers were added to the list during the past year, East Daggersfontein, Venterspost, and Marievale.

YUGOSLAVIA

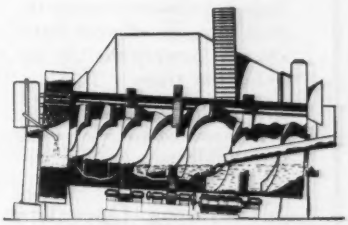
Steady Operations at Trepca Mines, Ltd.

New lead smelter producing at rate of 20,000 tons refined lead per year—Production at Kopaonik mine increasing

▶ Trepca Mines, Ltd., has continued its operations successfully in Yugoslavia and is able to report a net profit for the year to Sept. 30 of £178,124, which compares with £50,691 the previous year. It has resumed dividends with the payment of 5 percent (3d. per 5s. share) free of tax. Output is continuing at the rate of about 600,000 tons of ore per year. The lead smelter built by a subsidiary has been in operation since Dec. 21, 1939, and is now turning out 20,000 tons of refined lead per year. Work on the construction of a zinc smelter has been suspended. By arrangement a portion of Trepca's production is sold by the Yugoslav Government for dinars, while the remainder is sold by the company and the proceeds retained in London. This arrangement worked excellently last year. Ore reserves above the 435 metre level of the Stantrg mine were resampled and measured during the year and now amount to 4,848,000 tons. Preparations are being made to produce at the rate of 10,000 tons of ore monthly from the company's Kopaonik mine.

A CLASSIFIER WITH NO INTERNAL MOVING PARTS

"The most practical and common sense wet separation device so far developed" says a user of the Hardinge Counter Current Classifier. Bulletin No. 39 tells why.



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TRI-VIBE triple-powers the free-swinging screen jacket and amplifies the differential, dynamic vibration to every square inch of screen cloth. It boosts capacity in *fine mesh screening*, and permits the use of shorter, smaller screens.

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Specifically designed to answer intermediate mine haulage problems.

Outstanding Operating Features:

A totally enclosed, oil bathed spur gear drive.

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AUSTRALIA

Various Types of Ore Deposits Being Developed

More attention given to investigation of iron, bauxite, and magnesite possibilities of the Commonwealth—Renison Associated Tin Mines improves tin recovery from low-grade ore

Western Australia

▶ New Golconda Mines, N. L., which formerly had a property at Lake Austin, has taken an option over the Iron Duke lease, at Coolgardie. This property, which adjoins the Tindals mine on the west, has been worked to a depth of 150 ft. only, but ore from this level is reported to assay 20 dwt. per ton.

▶ Lady Shenton Gold Mines (1934), N. L., which is examining the Maranoa leases, near Menzies, believes that a grade of 5 to 6 dwt. per ton may be obtained from the property, which would necessitate the mining of at least 1,000 tons monthly to yield a satisfactory profit. A development program directed towards this end has been planned.

Victoria

▶ Deborah Gold Mines, Bendigo, recently cut an east back in the shaft at a depth of 1,507 ft. This is believed to be connected with a formation the cap of which lies about 100 ft. above.

▶ Delivery of 1,300 tons of material for the superstructure of the gold dredge being erected for Harrietville (Tronoh), Ltd., Harrietville, has been completed. Several machinery units have also arrived at the site. The area contains 96,000,000 cu.yd., averaging about 1.9 gr. per cubic yard, and will have an estimated life of 22 years at the rate of 350,000 cu.yd. monthly.

Tasmania

▶ A company named Rutherford Iron Mines, N. L., has been formed to develop a small but high-grade iron ore deposit at Natone, near Burnie, Tas. The deposit is estimated to contain at least 2,000,000 tons of ore, which it is proposed to treat by electric furnace methods for the production of pig iron, and therefrom wrought iron and steel tubes and fittings.

▶ Montana Silver Lead, N. Y., which operates a small mine near Zeehan, Tas., has decided to suspend production on account of the difficulty of marketing its concentrates.

▶ Renison Associated Tin Mines, N. L., which is treating the low-grade, heavily sulphidic ores of the Renison Bell field, West Coast of Tasmania, had a loss of £A2,136 for the year to June 30, during which production was much interrupted, but has since improved its position. The milling method in vogue up to the present has been the flotation of the iron sulphides, leaving the tin to be recovered from the tailing by gravity methods. This has resulted in the loss of much fine tin, which has gone into the final tailing. The perfecting of a flotation process for the recovery of the fine tin is now reported by the company, which in addition to current ore, proposes to retreat the old tailings by the process, for the recovery of their fine-tin content.

South Australia

▶ The Broken Hill Proprietary Co., Ltd., has taken an option over a magnesite deposit in the Mundallio hills, 8 miles from Port Augusta. Preliminary surveys indicate that the deposit, which has been worked by the present holders for several months, is of large size.

New South Wales

▶ Leases near Tingha, in the northeast of the State, believed to contain over 4,000,000 tons of bauxite, have been acquired by the Broken Hill Proprietary Co. The grade of the deposit has not been stated, nor have the company's intentions with regard to it. The company uses a small tonnage of bauxite in its steel-making operations.

Equipment Progress

(*Continued from page 99*)

Hardinge Co., York, Pa., announced its "Auto-Raise" thickener that automatically relieves the thickener of an overload in the tank that may be at the periphery or in the center of the tank. The company also brought out its sand clarifier, ranging in capacity from a few gallons up to 5,000 g.p.m., for the clarification of feed water, brine, and cyanide solutions.

JIGS — Late in 1940 Allis-Chalmers Mfg. Co. developed its new Conset jig, operating on the principle of controlled settling. Accurate control of the stroke cycle produces a differential pulsion and suction, permitting a longer period of settlement or "differential settling." A Conset jig for gold recovery was also developed.

Pan-American Engineering Co., Berkeley, Calif., streamlined its 12-in. jig for recovering gold from placer operations. The company also developed an amalgamating barrel that may be cleaned in such a manner as to eliminate any possibility of salting.

Denver Equipment Co., Denver, Colo., announced its 4 x 6-in. jig for use as a cleaner unit designed to handle 150 to 500 lb. per hour of concentrates continuously discharged from a larger jig. Mill & Mine Supply, Inc., Seattle, Wash., improved its

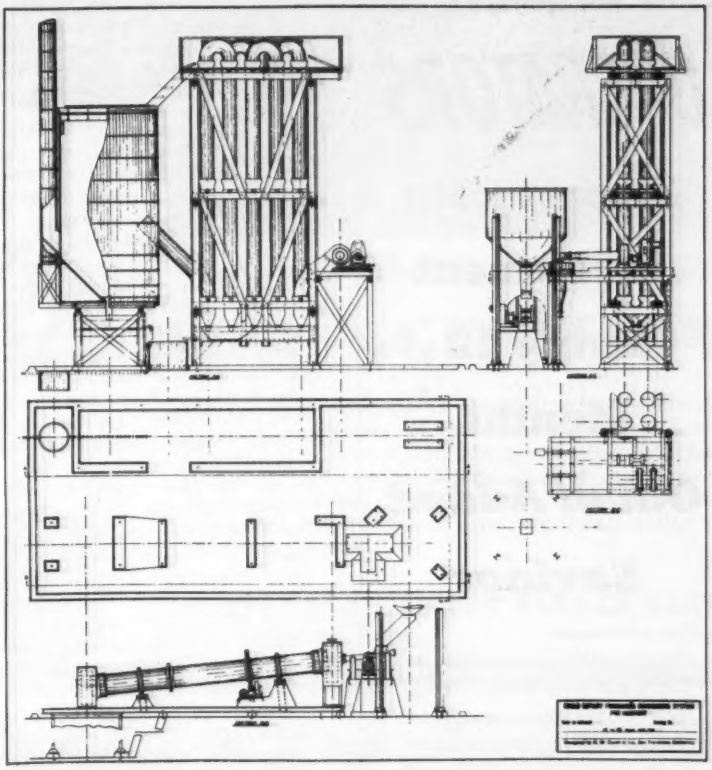
Titan Twin diaphragm jig for mineral recovery and use on gold dredges.

MINERAL SEPARATION—The general design trend of magnetic separators manufactured by Dings Magnetic Separator Co., Milwaukee, Wis., is a greater use of stainless steel and use of Nylon in insulating magnet coil wires. The company's Type K Crockett magnetic separator has been developed to a point where the coils may be removed at any time without destroying the watertight, transformer oil filled, stainless-steel casing. The Dings high-intensity induced-roll magnetic separator has undergone improvements for broader use in production of tungsten concentrates. A separator said to be particularly effective for treating finely ground powdered metal was announced by Sterns Magnetic Mfg. Co., Milwaukee, Wis. The company also introduced a magnetic pulley separator unit to separate brass and iron turnings. In the field of electrical precipitation, Western Precipitation Corp., Los Angeles, Calif., designed and installed a new type of Cottrell separating unit requiring less space without affecting operating efficiency.

SCREENS—A new type, announced by Nordberg Mfg. Co., Milwaukee, Wis., is its rod deck screen. The screening surface consists of rods instead of the customary wire mesh or perforated plate. These rods permit long slotted openings, which affords rapid passage of the undersize, giving the screen more capacity. The rods can be individually replaced in a short time without the use of tools. A dust-tight housing incloses the screen. Productive Equipment Corp., Chicago, Ill., announced its gyroset vibrating screen, having the principle of unbalanced weight to force a concentric to oscillate the deck structure. Robins Conveying Belt Co., Passaic, N. J., adapted its Eliptex vibrating screen for removing heavy-density medium from iron ore, used in the differential density process of mineral separation. To protect against the dust hazard in screening dry materials, The Diester Concentrator Co. equipped its Type C Leahy screen with dust-proof inclosing assemblies. The company also announced its new Super Duty diagonal-deck No. 6 concentrating table successfully used in the metal and non-metallic field.

FILTERS—A new filter press was announced by T. Shriver & Co., Harrison, N. J., which has the feature of quick cleaning. Special frames have been designed with ribs which support the filter cloth so that pressure can be applied behind them.

QUICKSILVER



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The reason GOULD plants are able to perform in this manner is based on 25 years of specializing in the business of improving quicksilver plant design; of specializing in lowering cost of plant operation; of specializing in increasing recoveries. As operator of several of the largest quicksilver mines in the country, our plants are constantly tested, improved on, checked, and RE-CHECKED.

Bring your problem to us—let our engineering staff and laboratory give you the result of our specialized experience in this field—let us design your plant—and erect it—be assured of obtaining a MODERN quicksilver plant, recognized as STANDARD THE WORLD OVER!

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Recover Jig Investment Every 12 Months *Out of Added Savings*

PAN-AMERICAN JIGS can increase recoveries from placer operations enough to return your jig investment at least every 12 months *out of additional savings during the life of the operation.*

They also provide the best possible commercial recovery of your gold.

Pan-American Jigs are doing these things today in many operations. Let us prove they can.

Large Placer Jigs for roughers. Small Pulsator Jigs for cleaners, or for roughers on small operations.

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The cake is loosened by means of water at 30 to 50-lb. pressure introduced in the drain cocks of the frames. A long series of runs are said possible without opening the filter for cleaning. A self-contained unit operating from an ordinary light circuit to clean filter drums was brought out by the National Electric Manufacturers Co., New York, N. Y.

PUMPS—Disposal of underground water in mining districts, particularly in deeper operations that are becoming more common in this country, forces many operators to devote serious consideration to this problem. Performance and efficiency in pumps has advanced principally through improved design. Alloys offer greater resistance to pump corrosion and today's pumping units whether large or small, therefore assure mine operators greater service than ever before. Fairbanks, Morse & Co., Chicago, offered its Builttogether pumps in 1- to 4-in. sizes having bronze impellers directly mounted on the shaft of motors. These units are applicable to many classes of general pumping service. The company's deep-well turbine pumps are reported finding increased use in the mining field.

Called a revolutionary improvement by the Peerless Pump Division of the Food Machinery Corp., Los Angeles, Calif., is that company's Hi-Lift unit that is not a turbine, plunger, or injector type pump. Instead of using centrifugal impellers or piston-acting plungers, this pump utilizes a stainless-steel helical-shaped rotor which rolls at half the usual pump speed, inside of a cutless rubber stator bearing in which is molded an internal helix. The water is literally squeezed spirally through the pump, with capacities ranging from 500 to 3,500 g.p.m. This company also announced a new water-lubricated bearing for deep-well pumps. Among portable air-operated sump pumps for mine use was the Size 35 brought out by Ingersoll-Rand Co. It weighs 75 lb. and is said to handle, at 80-lb. pressure, 100 g.p.m. at 150-ft. total heads. The company also announced design and installation in a large Arizona copper mine of two 6-stage centrifugal pumps, with total head of 1,250 lb. and 1,750 shaft horsepower, and 3,550 r.p.m. These are believed to be the largest centrifugal pumps with highest head in the industry.

Allis-Chalmers Mfg. Co., announced an "all-in-one" centrifugal pump called its "Electrifugal." This unit has a special motor with a one-piece cast-iron motor yoke and pump bracket. Present head for this type pump is 160 ft., but larger sizes are now being designed.

The Southwestern Engineering Co., Los Angeles, Calif., introduced its diaphragm pump that is said to afford maximum operating flexibility, with features of stroke adjustment by means of a hand wheel, permitting changes in stroke length and pulp density without shutting down the pump.

Byron-Jackson Co., Los Angeles, Calif., featured its latest submersible units that can be used in series for pumping large quantities of water from great depths, thereby facilitating greater speed in shaft sinking operations. Allen-Sherman-Hoff Co., Philadelphia, announced its packless pump, having no packing, no stuffing box gland, or mechanical seal, for pumping under widely fluctuating conditions.

The American Manganese Steel Division of The American Brake Shoe & Foundry Co., Chicago Heights, Ill., announced its type A industrial centrifugal pump for handling abrasive mixtures. Among features of this unit is the placing of the stuffing box of the pump on the entrance side, which minimizes stuffing-box nuisances. The company's Type QW vertical shaft pump, requiring small space, is offered for mill installations. A new type of diaphragm sludge pump, permitting variation of rate of discharge by means of a hand wheel while the pump is in operation, was announced by The Dorr Co., New York, N. Y.

Viewed as an unusual advance in industrial packing material design, the Garlock Packing Co. announced its Lattice-Braid packing for many industrial uses in which every braiding strand passes diagonally through the body of the packing at an angle of approximately 45 deg. Crane Co., Chicago, Ill., announced a new line of steel gate, globe, angle, and check valves from ¼ in. to 2 in. for industrial service.

EXCAVATORS—Expansion in the mining industry in 1940 found a greater use for earth-moving equipment, such as excavating and stripping shovels, scrapers, bulldozers, and earth-conveying machinery. Bucyrus-Erie Co., South Milwaukee, introduced its 54-B, 2-cu.yd. 207-hp. diesel machine, featuring a twin single-part hoist, twin crown, and a rolling-type dipper handle. Other developments by the company were its new line of four-wheel carry scrapers, available from 6 to 13 cu.yd., and new bullgrader and bulldozers for Inter-National Trac tractors. A new fast loader designed for digging and dumping without maneuvering or turning, and permitting free oscillation of the tractor tracks, was announced by Athey Truss Wheel Co., 5631 West 65th St., Chicago, Ill.

Among the smaller shovels announced in 1940 was the LS-60, a

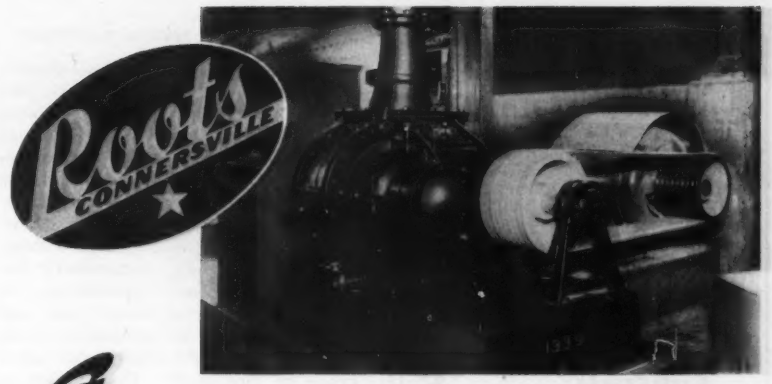
2-cu.yd. convertible shovel, dragline crane, by the Link Belt Speeder Corp., Chicago, Ill. This unit has a 60-hp. gasoline or diesel engine, and has two travel speeds. The company also brought out LS-100, a 1¼-cu.yd. convertible shovel.

The Northwest Engineering Co. announced a new 1-cu.yd. convertible shovel, Model 4-1, that features new principle of design and construction. The upper and lower bases of this model are special heat-treated alloy steel castings, and all high-speed shafts are mounted on ball or roller bearings, and practically all gears operate in a bath of oil.

For exploitation suited to drag scrapers and slackline cableway, Sauerman Bros., Chicago, Ill., announced a new scraper bucket designed especially for digging hard-packed conglomerate. Tapered sockets for the digging teeth are cast integral with the lip, and the renewable tooth points, fitting into these sockets, are longer than usually specified for scraper buckets. These buckets are available in sizes from 2 to 15 cu.yd. The company's scraper-loaders mounted on crawlers seeing service in open-pit mining were also introduced during 1940. Sauerman engineers designed its Hydraulic Operator unit for operating scraper and cableway hoists with maximum ease from remote-control stations. This device permits the operator to be located wherever is most convenient, regardless of hoist locations.

Among the tractor-drawn earth-moving equipment announced in 1940 are several new units by R. G. LeTourneau, Inc. Its third and smallest Tournapull, Model C, for long-haul dirt moving, powered by a Caterpillar four-cycle, six-cylinder D-468 diesel engine, was introduced. The Model LU carry all cable-controlled scraper with a struck capacity of 15 and a heaped capacity of 19 cu.yd. was also announced. Among the bulldozer type of equipment, the XD7, having a blade lift of 3 in. above the ground, was brought out. Interchangeable with the company's carry-all scrapers on either the standard or super Model C Tournapulls is the company's new W-10 Tournotrailer, with a struck capacity of 9.5 cu.yd. and a heaped capacity of 12 cu.yd. In dumping, the load is dropped back of the wheels through an ever-widening opening as the body slides back over the stationary bed.

In 1940 two-cycle diesel power was made available in crawler tractors when the Allis-Chalmers Mfg. Co. introduced its HD-14, HD-10, and HD-7 diesel tractors. Features of these units include bimetallic clutches and brakes, truck wheels with 200-hour lubrication intervals,



1200 CFM, 10½ lb. blower used for agitation in Canadian gold mine.

Air FOR AGITATION

Wherever air is used in ore refining, whether for flotation machines, smelters or converters, Roots-Connersville have a suitable blower that will help reduce operating cost. As builders of both positive displacement and centrifugal type blowers, we are in position to recommend equipment best suited for your requirements.

IN HANDLING AIR AND GAS Experience Counts

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4102 Washington Avenue Connersville, Indiana

WHEAT
THE ENGINEERED
CAP LAMP

Engineered for
MORE LIGHT WITH LESS WEIGHT

Wheat has always built on the basis of maximum candle-power and minimum weight consistent with good service life. Now by the use of the Krypton gas filled bulb in combination with reflector design, it is possible again to increase effective illumination on the working surfaces without increasing weight.

Simplification of design, elimination of moving parts, light-weight strong plastic construction and the sponge wood separator battery have all contributed to the reduction in weight.

AND REMEMBER—Wheat has—An extra work light bulb good for 24 hours—Self service handling—A type of light that is right for every mining condition—A non-spillable battery.

Get Wheat and you get the most "Modern Cap Lamp of the Day."

Write for detailed fully descriptive printed matter today.

WHEAT CAP LAMP

KOEHLER MFG. CO.
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WESTERN U.S.A. F. O. BUELARD CO. SAN FRANCISCO, CAL.
CANADA H. C. BURTON & CO. HAMILTON, ONTARIO

BETTER LIGHT - LESS WEIGHT
NON SPILLABLE

THE ROSS FEEDER

Completely Controls

the flow of any size material from Storage Bins, Hoppers or Open-Dump Chutes to Crushers, Conveyors, Screens, etc.

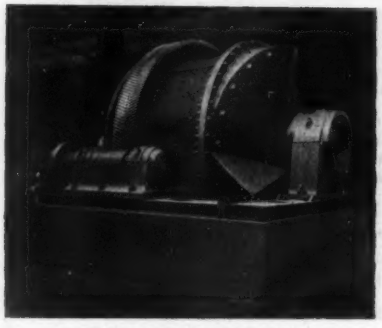
High in efficiency. Low in maintenance and power consumption.

Furnished in sizes to suit your operation. Scalping unit to fit your chute if desired. Send full particulars for recommendation.

ROSS SCREEN & FEEDER CO.

10 Rector Street, New York, U.S.A. — **8 Victoria Street, London, S.W.1, England**

PROGRESS in BALL MILLS



10½' x 16' Williamson Mill

Savings in power, ball and liner consumption are part of the per-ton economy distinguishing Williamson Mill performance—and each year finds them used in more well engineered plants.

Williamson Mills are different—their *effective* grinding action efficiently produced by a scientifically designed drum, assures lower grinding cost.

"Its the shape of the drum that does it"

Let us help you solve your grinding problem

WILLIAMSON COMPANY

582 Market St. San Francisco, Calif.

and a new track release mechanism.

GOLD DREDGING—An interesting development in equipment in 1940 for exploiting shallow gold placer deposits was the Becker-Hopkins "single-bucket" dredge. Manufacturing and sales rights on this dredge have been acquired by Yuba Manufacturing Co., San Francisco, Calif. The dredge is a self-contained floating unit designed particularly for operation on shallow properties, in limited areas, or in narrow canyons where it would be impracticable to operate bucketline dredges or other types of equipment. Power can be either electric or diesel, to meet requirements.

A rivetless bucket for gold dredges is reported finding wider acceptance by The American Manganese Steel Division of the American Brake Shoe & Foundry Co., Chicago Heights, Ill. This type of bucket lip is said to allow dredge operators to change worn lips in a remarkably short time.

Designs of portable equipment for the small placer operation also advanced. Denver Equipment Co., Denver, Colo., introduced a portable caterpillar tread unit whose flowsheet for recovering placer gold includes a 16x24-in. rougher Denver mineral jig, and an 8x12-in. cleaner jig. Motive power is a Caterpillar diesel electric unit supplying power to individual motors to drive trommel screen, rotating classifier, water, and sump pumps. The unit can be moved from place to place by tractor. Mill and Mine Supply, Inc., Seattle, Wash., announced production of a 60-cu.yd. dryland dredge, equipped with jigs and amalgamator. A completely equipped small portable gravel-washing unit with 1½-h.p. gasoline engine, having a capacity of 2 to 2½ cu.yd. of bank-run gravel per hour, was introduced by the Universal Dredge Mfg. Co., Denver, Colo.

FURNACES — Greater activity among quicksilver mines has resulted in numerous installations of equipment serving this field. H. W. Gould & Co., San Francisco, Calif., made some refinements to its equipment and produced some furnaces of large capacity during the year. Cottrell Engineering Co., Los Angeles, Calif., announced its new direct-fired concurrent rotary furnace for mercury and other ores. Furnaces are supplied from 20 in. in diameter to 11 ft. long up to 4 ft. in diameter and 60 ft. long. A notable advance in electric assay furnaces was announced by the Denver Fire Clay Co., Denver, Colo. Advantages listed by the company are constant temperature and ventilation control, economical, and avoidance of gas disposal.

WELDING — Great savings are realized each year in the mining industry by oxy-acetylene and electric welding. The Linde Air Products Co., New York, N. Y., announced a new medium-pressure oxy-acetylene blow-pipe Type W-109, for welding light-gage metal and a cutting attachment for cutting iron and steel up to 1 in. in thickness. A portable oxy-acetylene cutting unit hydraulically controlled known as CM-35 bar-cutting machine for cutting rounds or squares was also brought out by the company.

The Lincoln Electric Co., Cleveland, Ohio, announced a new 300-ampere diesel engine driven arc welder, equipped with gasoline engine starting instead of the conventional motor starter with storage batteries.

Where heavy work is required and welds can be made in horizontal or flat positions, alternating-current arc welders are reported in greater demand. Among the developments in the welding field made by the General Electric Co., Schenectady, N. Y., are the new 300- and 500-ampere a.c. arc welders with built-in power factor correction; a new resistor-type d.c. arc welder for mine service; a new d.c. arc welder providing any welding current from 25 to 250 amperes, and a new gage for easily and rapidly checking the size of fillet welds. Arc welding electrodes by the company include its Type W-22 electrode, which eased manipulation, when welding in vertical or overhead positions, reduced spatter losses, and increased speed of deposition. A new electrode W-93 (a.-c. or d.-c. application) was developed by the company to meet requirements of hard-surfacing applications where it is intended to build up steel surfaces to resist shock, abrasion, and rolling impact, such as building up all ends.

The American Manganese Steel Division of the American Brake Shoe & Foundry Co., Chicago Heights, Ill., introduced its Amsco Mo-Mang welding rod for building up worn high manganese, carbon steel, and gray iron castings. For protection to the welder, the E. D. Bullard Co., San Francisco, Calif., offered its safe-weld helmet, weighing 17 oz., equipped with chipping lenses in addition to welding lenses of desired shade.

VENTILATION.— Provision of sufficient fresh and cool air in mines is an objective constantly sought by mine operators, and advances in equipment for this purpose have made noteworthy progress. Refrigerating machines for cooling water for mine air conditioning increased during the last year. The Carrier Corp., Syracuse, N. Y., reported another machine added to the Magma Copper Co., in Arizona, and two were added

in the Robinson Deep gold mine, in South Africa, where five large units are now employed to reduce the temperature in deep mining operations. Deep gold mines in the Kolor field, India, are also installing air-cooling equipment.

A device called the Mine Vent Coupler for rapid coupling of lengths of flexible ventilation tubing was announced by American Brattice Cloth Corp., Warsaw, Ind. Two products applicable for mine ventilation were announced by Hersey & Co., Seattle, Wash. For exhausting air, light dusts, and gas, a wire-reinforced rubberized tubing known as Flexaust was announced; the other was a new light-weight flexible tubing called "Bloflex" for mine ventilation.

MINE SAFETY—The ever-increasing vigilance among mine operators to impress the importance of safety-first practices in all phases of the industry was further supplemented in 1940 by new devices for such purposes. Among equipment announced by the Mine Safety Appliances Co., Pittsburgh, Pa., was its safety insoles to prevent injuries from objects driven through the rubber or leather soles of the workers' shoes. A miners protection suit made of durable black rubber was offered by the company to withstand hard wear experienced in wet mining operations. The company also brought out a safety belt tail-line for use in lowering men. To protect the eyes against small flying particles, a skullgard eyeshield was also introduced. A device called the MSA telephone mask was also brought out. This consists of a telephone transmitter and receiver built into the face-piece of a mask, thus permitting clear, dependable two-way conversations between a mask wearer and the fresh-air base located at some distance, or between two widely separated mask wearers. No batteries or other external power source is required, as all power used is derived from the voice itself.

Among respirators, there were some innovations. The American Optical Co., Southbridge, Mass., introduced its R-1000 respirator, consisting of one basic respirator and five interchangeable filters for protection against toxic dusts. A R-9100 respirator for protection against pneumoconiosis-producing dusts was also brought out by the company. The Koehler Manufacturing Co., Marlboro, Mass., announced its new Model GW Wheat miners electric cap lamp featuring a more intense light, simplified design, lighter weight headpiece, and adaptability to any charging system. The lamp also has an extra "standby" bulb providing ample light for working underground.

For protection against lead dust and

NICHOLS HERRESHOFF MULTIPLE HEARTH FURNACES

DRYING - ROASTING - CALCINING

IMPORTANT DEFENSE FACT:

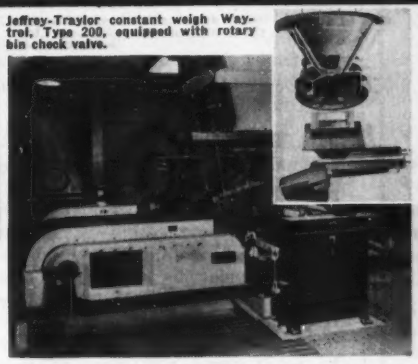
The performance record of Nichols Herreshoff Multiple Hearth furnaces in processing a wide variety of materials over a period of more than fifty years is unequalled.

Their flexibility of design, compactness, low power consumption and simplicity of operation have resulted in thousands of furnace installations in this country and abroad.

If you have a problem involving any of these processes, write for Bulletin No. 206 which describes the furnaces in detail.

NICHOLS ENGINEERING & NERCO RESEARCH CORP.
60 WALL TOWER NEW YORK, N. Y.
UNIVERSITY TOWER MONTREAL, P. Q.

JEFFREY-TRAYLOR ELECTRIC VIBRATION



Jeffrey-Traylor constant weigh Waytrol, Type 200, equipped with rotary bin check valve.

...A PRINCIPLE THAT SPELLS Lower Cost Material Handling!

AS AN EXAMPLE... BETTER CRUSHING RESULTS FROM THIS ALL-ELECTRIC BIN-CHECKED WEIGH FEEDER.

● Uniform feed gives greater efficiency in the operation of reduction units . . . that's why Jeffrey-Traylor weigh feeders and rotary bin valves (patented) have steadily lowered costs in this phase of metal mine service. By high frequency electric vibration, a uniform head of material is always available . . . this, in turn, is controlled by the "electric brain" of the Waytrol thus assuring a constant, positive feed for ball mills, crushers, etc. This sound principle of electric vibration, plus electric control, is a feature of J-T screens, feeders and conveyors. Let us demonstrate the many benefits with a system that's entirely electrical. Write for Catalog No. 650—J.

JEFFREY-TRAYLOR DIVISION
The JEFFREY MANUFACTURING Company
974-99 NORTH FOURTH STREET COLUMBUS, OHIO

SAUERMAN
POWER SCRAPERS

Store and reclaim for a few cents per ton . . .

Reclaiming Muriate of Potash in Warehouse.

Mill in Norway Uses 3 Small Sauerman Scrapers for 90,000-Ton Open Storage of Ore.

At mines, mills and smelters, Sauerman Power Scrapers are being used most effectively in the stockpiling of both raw and processed materials, either in the open or inside buildings.

One of the great advantages of this equipment is its flexibility, which permits Sauerman engineers to adapt each scraper installation to the exact needs of the job.

Moreover, the first cost of a Sauerman installation is reasonable, maintenance amounts to very little, and the simplicity of operation makes it possible to place the control of even the largest installation in the hands of one operator.

For illustrations and details of the varied forms of Sauerman Power Scraper installations for storing and reclaiming, write for Bulletin No. 153. If you are interested likewise in the use of scrapers and cableways for excavating, also ask for catalog No. 19.

SAUERMAN BROS., Inc.
484 S. Clinton St., Chicago

equipment for controlling one or more a.-c. synchronous converters in mining service was announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The complete unit, about 8 ft. long, consists of high-tension equipment, a.-c., starting and running panel [illegible]y panel, and a d.-c. panel. All r[illegible]s, meters, circuit breakers, and auxiliaries are surface-mounted on ebony asbestos panels. A d.-c. sectionalizing switch improving regulation feeder voltage for mining service and new heavy-duty skip-hoist controllers for squirrel-cage motors were also announced.

Caterpillar Tractor Co., Peoria, Ill., announced two new models of its diesel electric sets, the 88-91 and the 77-84, developing 41 and 34 kw. respectively. For use at mines in high altitude, the Murphy Diesel Co., Milwaukee, Wis. offered its ME650 supercharged six-cylinder 10-hp. diesel engine.

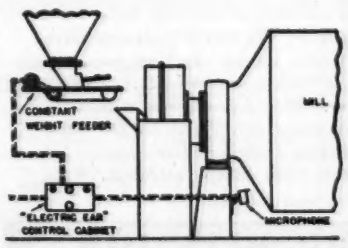
Allis Chalmers Mfg. Co. brought out a new distribution transformer, having cadmium plated three-way terminals that permit leads entering from any one of three directions.

Among variable-speed control units the Reeves Pulley Co., Columbus, Ind., announced its Vari-Speed Jr., built in six different sizes of disk assembly for use with motors of from ⅛ to 1½ hp. Philadelphia Gear Works, Philadelphia, Pa., offered its new

SOUND OF MILL CONTROLS FEED

The "Electric Ear" is the only device that increases mill capacity and improves fineness control beyond that obtained with manually operated ball, pebble or tube mill.

Bulletin 42 tells why.



HARDINGE
COMPANY, INCORPORATED – YORK, PENNSYLVANIA
NEW YORK, CHICAGO, SAN FRANCISCO, TORONTO

metal fumes the E. D. Bullard Co., San Francisco, Calif., offered its respirator dust hood made of resistance light-weight cloth and a transparent acetate face shield permitting complete visibility. A trolley wire guard of rubber to protect miners against live trolley wires was announced by The Manhattan Rubber Manufacturing Division, Passaic, N. J.

ELECTRICAL EQUIPMENT — Motor design and its construction experienced notable changes in 1940. A new line of open squirrel-cage polyphase induction motors in integral horsepower sizes known as Tri-Clad was announced by General Electric Co., Schenectady, N. Y. It features streamlined appearance, more protection for mining requirements through the use of a cast-iron frame, advances in insulation by the use of the company's Formex magnet wire, and improved bearing design and lubricating arrangement, and it also incorporates the cast-aluminum rotor. The company announced a triple-voltage connection for making an induction motor suitable for operation on 220, 208, or 199 volts, without change in torque, starting kva., fuel-load speed, or efficiency. An air-flow measuring device was also built for accurately obtaining the volume of air flow from 40 to 3,000 c.f.m.

A new and automatic switchgear

HI-CASTE
DIAMOND BITS

SET IN
VANKOLITE
The Perfect Bit-Metal

Low temperature setting protects diamonds used in HI-CASTE Bits—and provides the lowest diamond cost per foot. HI-CASTE Bits are available in flat-faced and double-round-nose types. Also upon request, any other standard shape, size, wall thickness, or thread. Write for descriptive literature.

J. K. SMIT & SONS, INC.
157 CHAMBERS STREET
NEW YORK CITY

Planetorque motoreducer that protects all types of driven equipment from damage by overloading.

The most outstanding item among the electrical products of Fairbanks, Morse & Co., Chicago, was its one-piece centrifugally cast copper-spurs rotor for squirrel-cage induction motors. A device known as a scoop-control hydraulic coupling, useful for connecting a constant-speed electric motor to any machine requiring speed control, was a development by the American Blower Corp., Detroit.

Trumbull Electric Mfg. Co., Plainville, Conn., announced numerous detail improvements to equipment. Most important known was the company's new combination motor and disconnect in one cabinet. A small light-weight diesel engine suitable for mining operations was introduced by W. W. Gibson, 1801 Webster St., Alameda, Calif.

For refinement in titration, E. Leitz, Inc., New York, N. Y., announced an electrometric titration unit, which is a chemical titration in which the end point is determined by a change in voltage of two suitably selected electrodes.

Mineral Dressing

(*Continued from page* 81)

and a fundamental study of the process has been given by O. C. Ralston.

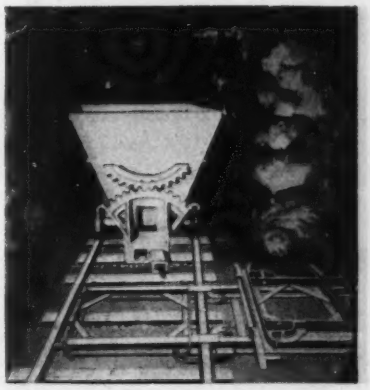
In the design of new plants the features that are being incorporated even more extensively than before are better lighting, direct drives, pushbutton operation, avoidance of pulp returns, and, generally speaking, simplicity of flow. New control devices are being contrived to make operations more nearly automatic and foolproof; for example, the Hardinge electric ear for control of grinding mills, and pulp-density controllers.

Dust collection is gaining interest not only as a means of decreasing losses of valuable minerals but also to better working conditions and to limit expensive litigation and industrial compensation (Robert T. Pring).

MICROSCOPY — Interest has increased in the use of the microscope to check on operations both for routine examination of products and in the execution of researches designed to better these operations. For good microscope work with opaque minerals, good polishing is needed. Even the best technique now available leaves somewhat to be desired, because it is slow, and therefore expensive, and because it does not give surfaces free of pits on all minerals. The design and operation of a polishing machine superior to the Graton-Vanderwilt machine, the best to date, would be welcomed by microscopists.

New—A MINE CAR TRANSFER FOR NARROW GAGE TRACK

Built to endure hard mine usage and designed to establish new records in mine car handling efficiency, the Canton Car Transfer operates on track gauges of 18 in. up to 24 in., with a rail minimum of 16 lbs., handling cars up to a maximum weight of 3,500 lbs. No slabbing is required on large tunnel operations to install this transfer, and very little in smaller tunnels . . . successful operations can be achieved with a minimum of space available for attachment to the track. Moving, detaching, etc. can be handled in *two minutes* by *two men*.



Permits a loaded train of cars, one by one to pass empty cars on a single track.

Innumerable plus benefits, such as the use of a single track for loading or dumping, the elimination of short cross cuts for car space, switches and additional track, are all yours with a Canton Transfer. As the work advances, so does the Transfer—it follows the mucker right up to the face. Investigate this Canton Mine Car Transfer—its features can be translated into lower cost loading and dumping on your operation. For additional details, write the

AMERICAN MINE DOOR CO.
2055 Dueber Ave. Canton, Ohio

INCREASE HAULAGE EFFICIENCY *For Defense* OF PROFITS

Less dead-weight per ton of pay load, speedy dumping action, maximum durability and an *exact* body-type and capacity for every purpose . . . that's how Koppel cars speed-up material handling, save on maintenance, *defend* your profits.

More than 20 side dump types stand ready to meet your every need. Why not inspect this Koppel line when you need cars? Koppel engineers will give you full cooperation.

Write FOR CATALOG

KOPPEL

20 SIDE DUMP TYPES

PRESSED STEEL CAR CO., Inc.
(KOPPEL DIVISION)
PITTSBURGH, PENNA.

Wet Grinding 1,250,000 Tons of ore

—and no doubt good for as many more

U·S·S Lorain Rolled Steel Plate Lining 3″ thick installed in an 8′6″ diameter wet mill has ground 1,250,000 tons of ore to date. Yet only half the thickness of the lining plate has been worn off.

This is typical of the records U·S·S Lorain Rolled Steel Liner Plate has been establishing. The original installation 1″ thick in a 7′ diameter wet mill, made in October 1935 by a large cement company, has never required any repairs even to the replacement of a bolt. It is still operating with the original lifting bars not yet reversed and still giving an efficient cascade angle—a record of over 20,000 operating hours. The service has proved so satisfactory that the same company has bought four additional linings for other mills during a five-year period.

And there is a good reason for such performance records. Because rolled steel is tougher, will not crack or fracture even when worn thin, U·S·S Lorain Rolled Steel Plate Lining remains usable beyond any possible limit obtainable with ordinary cast steel linings.

Lorain Rolled Steel Plate Lining is adaptable to any type of mill—in any diameter or length. It is available in whatever thickness best suits your grinding conditions.

Let our engineers discuss your grinding problems with you, and recommend the correct lining for your mills. There is no obligation for this service.

How Lorain Rolled Steel Lining increases grinding efficiency and cuts costs:

INCREASES USABLE DIAMETER OF THE MILL
—because the greater strength of the high carbon steel permits the use of a plate of reduced thickness. This gives increased output or greater fineness of grind.

ELIMINATES ROCKING OF LIFTING BARS
—for Lorain Lifting Bars not only wedge between the liner plates, but clamp over them.

PLATES ARE SYMMETRICAL
—thus can be either moved or reversed to compensate for excessive wear. This adds to the life of the lining and reduces costs.

BARS AND PLATES ARE EASILY INSTALLED
—for they are lighter in weight than cast sections, and their easily handled interchangeable sections result in less man-hours of labor and loss of mill operating time.

BARS ARE REVERSIBLE
—and a complete renewal of the cascade angle can be obtained by either reversing the lifting bars when one edge is worn, or replacing them when both edges are worn—without removing or renewing the liner plates.

U·S·S LORAIN ROLLED STEEL PLATE LINING

CARNEGIE-ILLINOIS STEEL CORPORATION

Lorain Division · Johnstown, Pa.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL